GAS JOURNAL, DEC. 18, 1940

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EDITORIAL NOTES

EFFECTIVE CO-OPERATION

IN these columns last week we said that the effects of enemy action would have been more disastrous and distressing had it not been for the foresight displayed and preparations made by the Gas Industry to render the best possible service in spite of grave difficulties and incalculable obstacles. Considering the odds, we added, temporary failure of gas supply has been remarkably rare, and the efforts made by gas undertakings to remedy defects and restore as speedily as possible the *status quo* have been praiseworthy.

We would like to refer specifically this week to the extraordinarily good work of the London Regional Gas Centre, an insight into which, we may mention, was given to the Press on Friday last. Fifteen important gas undertakings comprise this group, and within the area covered more than fourteen thousand miles of main carry gas from fifty-two works through more than three million meters to the homes and factories of a population of nine million two hundred and fifty thousand. Had it not been for the preparations made well in advance conditions would, as the result of intensive bombing of the area concerned, have been very different. As far back as the Spring of 1939 these fifteen gas undertakings in the London area combined to set up a skeleton organization which has since developed into the London Regional Gas Centre. This skeleton organization was a purely voluntary one formed of their own accord by the fifteen undertakings whose areas lie wholly or partly within the London Civil Defence Region. We think the public do not generally realize the extent to which the various works are interconnected to form what is in fact an enormous gas grid. This applies not only to works belonging to any one undertaking but, to a growing degree, to all the works supplying gas in this vast area. The expansion of this movement—and we would like to emphasize it—is one of the most important matters engaging the minds of the Management Committee of the London Regional Gas Centre at the present moment. The Committee consists of Messrs. R. W. Foot (Chairman), C. M. Croft, E. V. Evans, H. C. Smith, and A. E. Sylvester. The Manager is Mr. M. Milne-Watson. Each of these fifteen undertakings is responsible for maintaining its own civil defence organization—that is, the necessary organization for dealing with damage to gas-works, mains, and supplies in its own area. In this work all constituent undertakings are in the closest touch with the separate local authorities in the London Region.

The London Gas Centre comes into the picture when the damage suffered affects the output or distribution of gas in any area covered by the entire scheme. Information is received at the Centre of the mains affected, with details of all major damage from each undertaking ; and in the event of assistance being required for carrying out repairs, in the form either of men or of materials, the Gas Centre undertakes to obtain it and may request any undertaking to go to the help of another when the resources of any area have been heavily taxed. Assistance in mending mains has also been obtained from the Army Authorities through the medium of the London Region, and at the informal Press gathering to which we have referred Mr. Foot spoke of the great value of this help and paid tribute to the ready way in which officers and men of the units concerned had responded to the call and tackled energetically and successfully every job which they had been asked to undertake.

In the control room of the Gas Centre a day and night staff is employed receiving reports of damage to works and mains. There is also a control kept of the gangs and transport available for repair work. In the event of any one undertaking or district suffering exceptional damage help is immediately sent from less affected areas. In this way first-aid resources of all the undertakings are available to help any area in need. We may add that throughout the area six hundred telephones on one hundred and fifty exchanges are in use in the report and control centre, works, and depots, and four hundred miles of private telegraph lines—and this has proved a wise precaution—are available for communication.

Now on his appointment as Special Commissioner to the London Region Sir Warren Fisher, who was present at the gathering, was immediately impressed first with the vital importance both in home and in factory of gas supply, and secondly with the untold value of having in the London region an organization such as the London Regional Gas Centre. At his request the existing organization was placed on a definitive basis with the object of enabling undertakings in the area to speak with one voice on matters concerning war damage and to deal more speedily and in a combined way with problems created by heavy raiding on the Capital. The new basis for this organization was speedily arranged with the complete support of the fifteen undertakings. To-day the policy of the Centre is decided by the Management Committee, which has established three subcommittees to make recommendations in regard to all technical and financial matters. It is, indeed, a very fine example of co-operation within the Gas Industry for the one purpose of serving in the best possible manner the interests of the consumer. For the common cause, individual preferences have been sunk. And at the Press gathering in question Sir Warren Fisher paid high tribute to the Gas Industry. " Gas," he remarked, " is second only to water in its importance to the community," and he welcomed the opportunity of congratulating the undertakings concerned on the way in which difficulties resulting from enemy action are being met and overcome. We would record here his special tribute to the thousands of men in the Industry whose duty takes them out day and night into the worst of aerial warfare—the men who go out unflinchingly and cheerfully upholding the Gas Industry's aim of service under all conditions and in every circumstance.

" HABITABILITY "

AIR raid shelter heating is a matter of no little importance. In the " JOURNAL " in the past few weeks we have described and illustrated certain systems of heating—efficient and thoroughly hygienic—using as fuel either gas or coke. There is no doubt at all that the Gas Industry is carrying out an important communal service in making air raid shelters as congenial as air raid shelters can be. The cold weather is with us now, and the immediate requirement is heat. But there is another consideration, equally essential in the interests of health, and that is air conditioning as distinct from air warmth. The systems we have described can and do " condition " the air ; apart from warming, they ventilate and stem the possibility of spread of disease. In winter they can provide heat and movement of air, and in summer they can operate as cooling and refreshing agents. It is a question of the application of refined fuels to a new and unfortunately necessary piece of work. Gas and coke are bringing " habitability " into shelter nights.

Good News from Australia

WHILE we in this country have been (and are being) faced with troubles of an unusual kind in connexion with the Gas Industry, it is pleasing to learn that in Australia, where freedom is enjoyed from our special type of disability, marked progress continues to be made. Even so far away, of course, the war does affect business, for Australia is playing a noble part in it, and the Industry experiences this influence in more than one direction. On the one hand, large numbers of employees have joined for overseas service, while, on the other, the advantages of gas as a fuel for munitions manufacturers and other war necessities has had a great effect upon the demand. At the same time, business continues to expand on normal lines in a most gratifying way. One example of this is provided by the Gas Supply Company, Ltd., whose nine branches have shown a steady upward trend in consumption per meter from about 14,000 cu.ft. per annum in 1932 to over 26,000 cu.ft. in the twelve months ended June last. The Company have lately equipped several large laundries, including gas-operated plant costing £1,300 at the Cairns Hospital. They have also installed gas for cooking, water heating, refrigeration, and gas fires in numerous hotels and boarding houses, and space heating equipment in many picture theatres and large public halls and buildings. Of nine hotels recently rebuilt to conform to modern requirements at Mackay, Queensland, every one installed gas for cooking and water heating. There is now one gas refrigerator installed to every ten meters in use at all the Company's branches. At Cairns, which is within the tropical area of Queensland, there are 400 refrigerators installed—or one to every seven meters in use. In the past twelve months alone, the average gas consumption per consumer increased by 6%.

Free Billeting Service

Showing enterprise and helpfulness the Cannock District Gas Company, Ltd., of which Mr. C. R. Ingham is Engineer, Manager, and Secretary, has introduced a new public service—a free billeting service. It has adopted this move feeling that many people in bombed areas would like to secure accommodation in Cannock and district, and that there must be many people in the district who would be willing to share their homes with suitable tenants for the duration of the war. Those interested in offering or obtaining accommodation are invited to register at the Gas Company's Showrooms. While every effort is being made to satisfy both landlords and tenants, the Company is not, of course, accepting any responsibility as to the suitability of either.

The Address of the Birmingham Branch of Messrs. Falk, Stadelmann & Co., Ltd., is now 66–68, George Street, Parade, the telegraphic address and telephone numbers being as before—namely, " Effesco, Birmingham," and Central 8031–2–3.

The Head Office Telephone Number of Messrs. W. C. Holmes & Co., Ltd., Huddersfield, has been changed to Huddersfield 5281, and the firm would be grateful if their friends would make a special note of this.

The Gas Producer Association, Ltd., has been registered as a public company limited by guarantee, to encourage the use of indigenous fuels for internal combustion engines, etc. The subscribers include : C. S. Gardner, Sentinel Waggon Works, Ltd., Shrewsbury, and A. B. Walters, Palm Works, Acton, W. 3.

Middlesbrough, which Claims that it has the cheapest gas in the country, has just made another reduction in the price to prepayment consumers, as well as the abolition of the charge for meter rent to quarterly consumers. The concession amounts to about one penny per 1,000 cu.ft.

At the Last Meeting of the Stockport Council it was resolved to discontinue the discount of 2½% allowed for prompt payment for gas and electricity consumed through ordinary meters. This step has been taken in order to relieve the pressure of clerical work on the staff of the Borough Treasurer.

Salford Light, Heat, and Power Committee has asked the City Electrical Engineer (Mr. L. Romero), the City Gas Engineer (Mr. F. H. Goodwin), and the Lighting Superintendent (Mr. H. S. Whitehead) to prepare a joint report on a scheme of starlight lighting of roads which can be quickly put into operation.

Rebuilding after the War was the subject of an address on Dec. 3 by Miss A. M. S. Wilson, B.Sc., of the W.G.C., to a meeting of the Epsom Conservative and Constitutional Association. Miss Wilson described some of the work which had already been done in town-planning and rehousing, and made some suggestions of what was required in the new homes of to-morrow, and how these needs might be modified through the war. After the lecture there was a lively discussion, and several points were brought forward by members of the audience.

Personal

Mr. W. R. OLIVER, Display Officer to the British Commercial Gas Association, has joined the Ministry of Food Public Relations Division for special duties in connexion with the local development of Food Education, and upon taking up his appointment he has resigned his position with the B.C.G.A.

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Mr. LOXLEY M. PICKERING, Works Engineer at the Llanelly Gas Company's Works, Llanelly, has been appointed Assistant Engineer and Manager of the Bridlington Gas Company (United Kingdom), under Mr. F. S. Hunter, where he commenced his duties on Monday last. Mr. Pickering, whose father is the Engineer and Manager of the Hamilton Gas Company, New Zealand, came to this country some six or seven years ago.

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After many years' service, Mr. W. H. Swallow, Gas Manager at Uckfield, has retired. He was presented with a smoking cabinet by members of his staff and other friends.

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We regret that a mistake occurred in our announcement on Dec. 4 of the appointment to Dunfermline of Mr. CHARLES B. S. MITCHELL, who becomes Assistant Manager, not Manager. We apologize to Mr. James Campbell who is, of course, Engineer and Manager of the Gas Department.

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Mr. P. M. WATSON, Engineer and Manager of the Cleveland Gas Company, was presented by the Board on Dec. 11 with a silver salver, engraved with the signatures of the members, and an inscription stating that Mr. Watson had completed 25 years' service with the Company.

* * *

The award was announced last week of the Military Cross to P. VALON BENNETT, Assoc.M.Inst.Gas E., only child of the late C. Valon Bennett.

In the words of the official citation, the award was made " For conspicuous coolness and determination in action on numerous occasions when commanding his Heavy A.A. Section, R.A., in particular on Sept. 7, when his Section, having engaged and shot down an enemy bomber, was almost simultaneously subjected to low-flying attack by a hostile fighter when his quick grasp of the situation enabled the second machine to be engaged and destroyed. In all, his Section has brought down 12 enemy aircraft (confirmed as destroyed) during the last four months. This outstanding success has been in large measure due to the sound leadership of this officer and to his complete imperturbability when subject to bombing and machine-gun fire from diving attacks made by enemy aircraft."

Mr. Patrick Valon Bennett, Lieut., R.A., was a Territorial Officer before the outbreak of war, and left the service of the Rochester, Chatham, and Gillingham Gas Company on being mobilized for active service.

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Mr. J. H. WILLIS, A.M.I.Mech.E., Assoc.M.Inst.Gas E., of Messrs. Alexander Comley Ltd., Birmingham, who are agents for Messrs. Clayton, Son & Company, Leeds, and Messrs. Clapham Brothers, Keighley, has been appointed a Director of his firm. It will be remembered that Mr. Willis was Constructional Engineer to the City of Birmingham Gas Department prior to his joining the staff of Messrs. Alexander Comley.

* * *

At the last meeting, Alderman J. T. LORD was re-elected Chairman of the Stockport Gas Committee, and Councillor T. A. HOLLINSHEAD was elected Vice-Chairman in place of Councillor O. Taylor, who has retired.

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The Milbourne Medal, presented annually to the London and Southern Junior Gas Association, has for the year 1939–40 been awarded to Mr. J. E. COOPER, for his Paper entitled " Some Features of the Performance of Gas Water Heaters," read at a meeting held on April 5 last.

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Mr. D. L. HORLOCK, previously Assistant Secretary, has been appointed Secretary of the South Suburban Gas Company. The officers in charge of the main departments are now therefore : Mr. V. Simmonds, Engineer (Works) ; Mr. J. A. Gould, Distributing Engineer ; Mr. V. W. Stanton, Commercial Manager ; and Mr. D. L. Horlock, Secretary.

Forthcoming Engagements

Dec.

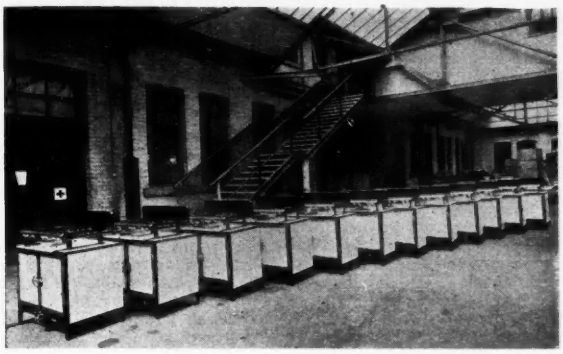
19.—Gas Research Board.—Refractory Materials Joint Committee, 2 p.m.

(There will be no meeting of the Central Executive Board of the National Gas Council during the month of December.)

1941.

Jan.

14.—I.G.E.—Council Meeting.



This photograph shows a batch of Radiation gas-heated hotclosets with hotplates on top—part of a much larger order—ready for delivery to a Ministry of Health Emergency Hospital. These appliances are installed in casualty wards for food and plate warming, as well as for the preparation, on the hotplates, of special diets for the patients.

The Kilburn Seam

Full Research Survey Paper

The Fuel Research Survey Papers deal with the physical and chemical survey of the coal seams of Great Britain. This survey aims at the collection of the data necessary for the utilization of the national coal resources to the best advantage, and is of considerable importance at the present time. With the publication by the Department of Scientific and Industrial Research of Paper No. 52 (H.M. Stationery Office, price 2s. net) in this series, details are now available of the Kilburn seam of South Derbyshire.

The seam was sampled, in the usual manner, by means of seven complete sections extending from floor to roof and taken from sites well distributed over the area. Each sample was subdivided in the laboratory and examined in detail, the determinations made being as follows : Proximate and ultimate analysis, forms of sulphur, carbon dioxide, chlorine, phosphorus calorific value, fusion point of ash, laboratory carbonization assay, and agglutinating value. In addition, a representative sample of the coal ash was analysed.

The seam, one of the lowest worked in the area, maintains a fairly uniform thickness of 4 ft. It consists of Top Brights and Bottom Brights, separated by the Hards, the Brights forming a household fuel, while the Hards is used for steam raising and general industrial purposes. It was found that the coal was of a very uniform nature over the limited area examined. As is normal in this area the caking properties were weak, the highest agglutination value recorded being 16/20, but in the low temperature carbonization assay the yields of tar and gas were high. The moisture content varied between 7 and 12% and the ash content between about 3 and 6%.

The volatile matter of the Brights was between 40 and 44%, while that of the Hards was lower, being between 37 and 41%. The total sulphur content of the whole seam was low. The calorific value, on an air-dried basis, was found to be between 11,230 and 12,850 B.Th.U. per lb.

The report includes a map showing the sampling sites, diagrammatic sections, and illustrations of the cokes produced in the laboratory assay apparatus.

This ingenious layout was arranged last summer on the works of the Hartlepool Gas and Water Company and brings with it a happy reminder of brighter days.

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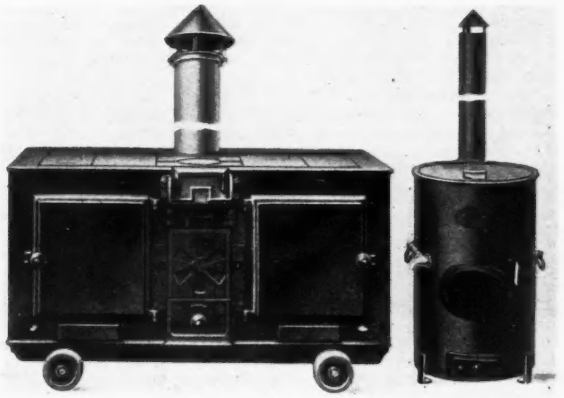
Submersible Pumps

Particulars of modern deepwell pumping equipment where A.C. is available are given in a new leaflet from Sumo Pumps, Ltd., Smethwick. This submersible pumping equipment is suitable for all forms of industrial, domestic and emergency water supply. The pump and motor unit is suspended in the well or borehole on the rising main, below the pumping water level. This method of working, a few years ago considered an impossible performance, is due to the clever design of such motors. The design of the Sumo units originates from Vienna, where many thousands of the units were formerly manufactured and sold all over the world, including a large number to this country. The units are now manufactured at the works of Sumo's parent company, Chance Brothers & Co., Ltd., Smethwick. The number of orders received from abroad and in this country encourages the hope that British enterprise will more than hold its own against any post-war Continental competition for the market.

A Mobile Cooking Unit

Our illustration is of an " emergency " range manufactured by Radiation Ltd. This range has already met with much success, having been used with great efficiency in dealing with communal feeding hastily arranged. Three units, we understand, are being



marketed—Nos. 1, 2, and 3, catering respectively for 100, 200, and 300 persons. There are three sizes of " Eagle " range, and each unit comprises 1, 2, or 3 " Eagle " field boilers, together with the appropriate size of range. The appliances are for solid-fuel firing, coke being, of course, admirably suited for the purpose.

Saunders Valves

Behind the prosaic title of " Saunders Valve Handbook 740 " the latest publication of the Saunders Valve Co., Ltd., Cwmbran, Newport, Mon., brings us forty pages of extremely useful information about the technical advances that have rendered the company's valves so essential to industrial efficiency. Chemical research has brought into being a range of plastic compounds of such durability that they can be used as tough, flexible engineering materials, and the improvement effected in the last few years in the wearing properties of such compounds are now well known. One reason why the troubles usual in the ordinary valve have been overcome is because the opening and shutting of the Saunders valve depends on a resilient diaphragm instead of on the continued accuracy of two moving machined faces ; thus the vicious circle of wear, leakage, corrosion, and jamming is obviated. Another reason for the success of the Saunders valve is the separation of the metal working parts from the fluid under control, thus saving them from the effects of corrosion and erosion. The Gas Industry stands high in the list of industries in which the Saunders diaphragm valve is in successful daily use, and the handbook recommends alternative types of bodies and diaphragms for handling most of the better known industrial fluids. There are five different grades of diaphragm and six different variations in the material for the bodies, and the recommendations are based on long, specialized experience which is constantly being supplemented as suitable new applications are discovered. Concentration, temperature, pressure, rate of flow, and presence of impurities all have an important bearing on the length of diaphragm life which may be expected. Although it is only about eleven years since the first patent for the Saunders valve was taken out, over a million of these valves are now in successful operation.

Hundreds More Community Kitchens Wanted

Photographs of Liverpool's splendidly equipped community kitchen which appeared in the " JOURNAL " of Dec. 4 are typical of much valuable work now being done by the Gas Industry throughout the country, and point the way to those undertakings that have not yet fully explored the opportunities for gas to contribute to the more domestic side of the national effort. " The nation that is not well fed loses both the power to work and the will to win," said Lord Woolton the other day in urging local authorities to establish community kitchens in their areas. The Ministry of Food is convinced that community kitchens are one of the best answers to the difficulties of feeding the people under wartime conditions and is anxious to see such kitchens set up everywhere. Already many kitchens have been established in London, Liverpool, Newcastle, and other big towns. Hundreds more are wanted, so that when supplies of food are not quite so plentiful as they have been up to now, when homes are bombed or housewives evacuated, when there is a temporary failure of gas or electricity, or when there is some interference with the transport of food, the organization in every locality will be able to meet the emergency.

The advertisement pages of the " JOURNAL " bear constant testimony to the ability of the appliance-making side of the Industry to cope with the feeding of large sections of the population. It has planned and equipped many such wartime centres in addition to the large-scale gas equipment supplied for works canteens, hospitals, institutions, and military establishments, and it is ready to co-operate with the local authorities or with gas companies in meeting what has been recognized as a national need. It is difficult to over-estimate the value of community kitchens, particularly to the housewife. It saves both her time and her strength ; it saves money, too, because there is a complete saving of fuel. From the national point of view it saves food because, instead of say 40 housewives buying and preparing food for 40 separate families, 200 people can sit down to the same meal prepared in the best and most economical way.

Much thought has been given to the kind of meals to be served at these centres, and the Ministry of Food's nutrition experts have worked out and tested by experiment menus which suit the tastes of the people, and at the same time provide, at low cost, all the necessary nourishing and protective elements. These menus will be varied according to the supplies of different kinds of food available, but always so as to secure the greatest health value. Local authorities now have full power to establish these centres, and it need not cost them a penny. The authorities that decide to operate community kitchens will have at their disposal all the expert advice that the Ministry of Food can offer, and the Ministry is willing to bear the cost of the capital expenditure involved.

The kitchens already opened in London and Liverpool are housed in buildings of the best modern design, charmingly decorated, with the finest possible equipment, and attractively furnished. Many centres also provide facilities for housewives to buy hot food and take it home. This is a great boon to the busy woman, herself engaged in war work of one kind or another. In one London centre catering for 5,000 people—2,000 adults and 3,000 children—excellent lunches have been served every day for three months at prices ranging from 4d. for a child's lunch to 10d. for a specially large lunch for men. Soup and bread cost a penny, and some typical menus comprise : Irish stew, dumplings, potatoes, carrots, apples, custard or rice pudding ; roast beef, potatoes, greens, plum duff or macaroni pudding ; steak pie, potatoes, marrow, jam sponge or tapioca pudding ; shepherd's pie, potatoes, beans, sultana pudding or rice pudding. The children have their meals in the dining room with some of the adults, while a large number buy the food and take it home in their own dishes.

The kitchen's customers range from two-year-olds to old age pensioners, and are a typical cross-section of the community. One woman with her husband, two children, and baby in arms, has used the restaurant regularly since it was opened, and says that she has made a weekly saving of 10s. on her housekeeping in food and fuel, and has found that her family get tastier and more wholesome meals. The community kitchen is also of great value to the country in freeing women at present tied to their homes by the necessity of cooking a midday meal for their families, so that they can undertake full time, instead of part time, war work.

" Central eating " is economy on the grand scale. If at least 200 people per day pay for hot meals, a community kitchen should cover its own running expenses. To many women the fact of being able to bring a dish to the centre, buy food and carry it home, is a perfect solution of domestic problems. They may still enjoy meals with their families in their own homes even in difficult circumstances.

Gas Undertaking Results

Brigg

After providing for loan and other charges and capital expenditure a gross profit of £1,488 on the operations of the Brigg (Lincs) Urban District Council gas undertaking for the past year is converted into a deficiency of £2,166. The estimates for the year had provided for a loss of approximately one-half of this amount, but the increased cost of coal and wages, and the reduced income from street lighting, had adversely affected the situation.

Chertsey

The year ended September last was marked by a further increase in the demand for gas in the area supplied by the Chertsey Gas Consumers' Company. The quantity sold to private consumers was 9% more than in the preceding year, but the smaller amount used for public lighting had brought the average increase in sales down to 3%. Owing to higher costs, the price of gas was increased by 1d. per therm as from the beginning of 1940. The accounts submitted at the meeting showed a balance of £6,730 to be carried to Net Revenue Account, which compared with £6,448 a year ago. Net revenue charges were much the same as before, and the dividends recommended on the various classes of shares were at the rates which had been paid for some time past.

Greenock

The report by the Committee on Gas Supply to the Corporation of Greenock, for the year ended May 15, states that the quantity of gas delivered and accounted for amounted to 744,189,600 cu.ft., which compares with 791,442,900 cu.ft. in the preceding twelve months. This represents a decrease of 47,253,300 cu.ft. The number of consumers increased during the year from 19,783 to 20,065—a gain of 282. Of the total number 13,197 are on the prepayment system. The over-all average price of gas during the year was just over 2s. 5d. per 1,000 cu.ft. A necessary advance in the price was made in two stages, In Greenock, free cooking appliances, free meters, and a highly popular free maintenance service are provided. At May 15 there was a debit balance of £1,992 in Net Revenue Account, after placing £4,000 to reserve.

Paisley

The accounts of the Gas Committee of the Town Council of Paisley, for the year ended May 15, show that the quantity of gas sent out from the works was 625,389,000 cu.ft., which compares with 626,431,000 cu.ft. in the preceding twelve months. The quantity accounted for was 620,298,000 cu.ft., as against 601,415,000 cu.ft., the loss being reduced from 3.99% to 0.81%. It was found necessary to make some increase in the price of gas during the year. The number of meters in use at May 15 was 28,349 (17,792 of them prepayment). The net Revenue Account shows, after meeting all charges, a surplus of £7,689, which is carried to Reserve Fund Account.

This photograph is of a recent link-up which the St. Austell Gas Company staged in connexion with the showing of the film " Gas Light " at the local cinema. The display was exhibited in the foyer of the cinema with posters supplied at very short notice by the B.C.G.A. and the cinema manager. Leaflets were available for the public illustrating various aspects of the Gas Industry's work for the nation in wartime. Great interest was evinced by the public in the exhibit. At the same time the Company Showroom window advertised the showing of the film.

INSTITUTION OF GAS ENGINEERS

1st REPORT OF THE CHAIRMEN'S TECHNICAL COMMITTEE; 1939-40

[Communication No. 234]

The membership of the Chairmen's Technical Committee is:

Robert Robertson, M.Inst.C.E. (*Chairman*); E. V. Evans, O.B.E., F.I.C. (*Vice-Chairman*); F. M. Birks, O.B.E., M.I.Mech.E.; Charles F. Botley, M.Inst.C.E.; George Dixon, B.Eng., M.Inst.C.E.; H. J. Escreet, B.Sc.Eng.; Stephen Lacey, B.Sc., M.Inst.C.E.; T. F. E. Rhead, M.Sc., F.I.C.; Harold C. Smith, J.P., M.Inst.C.E.; John Terrace, M.Inst.C.E.; the President, the two Vice-Presidents and the Honorary Secretary of the Institution (*ex officio*).

In the 5th Report of the Research Executive Committee, 1938-39 (Communication No. 216), attention was drawn to developments in the co-ordination and direction of research within the Gas Industry, leading up to the formation of the Gas Research Board through the collaboration of The Institution of Gas Engineers and of the Society of British Gas Industries. It was further stated that the Council of the Institution had requested the Gas Research Board to accept responsibility for prosecuting such research work as was already in hand under the guidance of the Research Executive Committee and such new work as might be, from time to time, submitted to the Board. The Research Executive Committee ceased to exist in November, 1939.

The technical activities of the Institution, other than the immediate control of research, continue to be directed by its Technical Committees dealing with Domestic Heating, Liquor Effluents and Ammonia, Lighting, Gas Works Safety Rules (including Gasholders), Pipes, and Meters. In order that the work of these Committees may be co-ordinated and overlapping avoided, a Chairmen's Technical Committee has been set up, to which these Committees are responsible and of which the Chairman of each Technical Committee is a member (*ex officio*). The following are its terms of reference: "The function of the Committee is, *inter alia*, to co-ordinate the work of the Technical Committees of the Institution and to report thereon to the Council".

The Chairman of the Committee is the Immediate Past President of the Institution (*ex officio*). The Chairman of the Council of the Gas Research Board and of its Research Committees are also members (*ex officio*) of the Chairmen's Technical Committee.

In this way the Committee, in addition to its more immediate function, affords a useful channel through which all the Technical Committees are kept in touch with the progress of current research investigations and these Technical Committees can, in turn, submit to the Gas Research Board any relevant problems which involve research. Normally the Committee meets shortly before each meeting of the Council of the Institution, but under existing conditions its regular meetings have unavoidably been restricted.

This 1st Report of the Chairmen's Technical Committee includes an account of the work and the names of the members of the Technical Committees responsible to it, together with summaries of two separately published Communications. It has been decided, in the interests of national economy, not to publish this year separate Reports of the Technical Committees.

The thanks of the Institution are due to those who serve on its Technical Committees. Such service and assistance are particularly appreciated under existing circumstances, when there are so many other urgent calls on time and energy.

It is greatly regretted that circumstances again preclude the holding of an Autumn Research Meeting for the presentation and discussion of Reports and Papers. Written Contributions discussing the Reports and Papers which are being published will be particularly welcomed and will be published, with the Reports, in the usual way.

Reports published by the Gas Research Board were also to have been presented and discussed at the Autumn Research Meeting of The Institution of Gas Engineers. Copies have, however, been made available to members of the Institution and written Contributions discussing the Reports will be welcomed. The Reports will be reprinted, with Discussions and Replies, in the Transactions of The Institution of Gas Engineers.

The Institution of Gas Engineers, through its Technical Committees, has maintained contact and collaborated with various Government Departments in connexion with the war effort. Arising out of such collaboration, the Institution has prepared and sent to all Gas Undertakings its Publication No. 225, "War-Time Street Lighting by Gas", and has produced, for the guidance of Gas Undertakings, detailed confidential memoranda dealing with the Recovery of Benzole and Toluole from Gas under Emergency Conditions and with the Manufacture of Concentrated Gas Liquor (15 per cent) at Small and Medium-Sized Gas Works under Emergency Conditions. Confidential memoranda have also been circulated regarding Street Lighting, Factory Lighting, Light-weight Steel Tubes, and various matters relating to Air Raid Precautions.

The Institution Gas Research Fellow (J. S. Forsyth, B.Sc.) has continued for a second year his investigation at Leeds University of flame phenomena. Publication of the Fellowship Report, 1939-40, is being postponed for a short time, to permit of the inclusion of certain important points at present under examination, but the Report will be available in the near future.

The Institution has continued to co-operate with the Joint Committee on Materials and Their Testing. The technical Discussions organized by this Committee have been temporarily postponed.

The investigations of the Association of British Chemical Manufacturers into Methods for the Detection of Toxic Gases in Industry, in which the Institution has collaborated, have resulted, during the past year, in the publication by the Department of Scientific and Industrial Research of the following Leaflets: No. 7, Carbon Monoxide; No. 10, Chlorine; No. 11, Aniline Vapour.

The Institution of Gas Engineers continues, through the Gas Industry Committee, Technical Committees and otherwise, to co-operate with the British Standards Institution in the preparation of British Standard Specifications. Its thanks are due to its representatives for their assistance and time given to this work.

§§§

Domestic Heating Committee

The membership of the Domestic Heating Committee is:

Stephen Lacey, B.Sc., M.Inst.C.E. (*Chairman*); J. E. Davis; Harold Hartley, D.Sc.; F. O. Hawes; C. A. Masterman, M.A., M.I.Mech.E., F.I.C.; E. W. Smith, C.B.E., D.Sc., F.I.C.; the President, two Vice-Presidents and the Honorary Secretary of the Institution (*ex officio*).

Society of British Gas Industries Nominees:
H. Angus, M.Sc., Ph.D.; T. F. C. Potterton.

The Domestic Heating Committee continues to consider the importance of different factors in relation to Comfort Conditions of Domestic Heating. It is also in contact with an expert *ad hoc* Committee on Domestic Heating and Ventilation in Relation to Human Comfort, recently set up by the Industrial Health Research Board of the Medical Research Council.

The Committee has under review the relative costs of gas fires and solid fuel fires in living rooms under conditions of continuous and intermittent heating. It is appreciated that such comparisons will vary considerably due to, *inter alia*, the personal element and individual requirements and that they can only be made in quite general terms. The Committee earnestly requests gas engineers possessing results of comparative trials of this nature to make such data available to it, more particularly as to the total annual gas consumption for a heating season (with a brief description of the gas fire, room and consumer's circumstances), previous average coal or coke consumption for the purpose, occupational period of the room, price of solid and gaseous fuel, and consumer's comments on the change.

The Committee has continued to collaborate, through the Gas Research Board, with the London School of Hygiene and Tropical Medicine in an investigation of the Ventilation of Rooms. Experimental work in this connexion has been temporarily discontinued.

The Committee has received and considered the Annual Reports of the Industrial Health Research Board, with particular reference to the investigations of the Board on Heating and Ventilation.

Gas Works Safety Rules Committee

The membership of the Gas Works Safety Rules Committee is:

F. M. Birks, O.B.E., M.I.Mech.E. (*Chairman*); H. E. Bloor, B.Sc., B.Eng.; J. M. Campbell, J.P.; Thomas Carmichael, J.P., M.Inst.C.E.; J. E. Davis; Thomas Hardie, M.Inst.C.E.; H. Hollings, D.Sc.; James Jamieson; J. W. Napier, M.B.E.; George C. Pearson, M.Inst.C.E.; T. F. E. Rhead, M.Sc., F.I.C.; C. S. Shapley, M.I.Mech.E.; Harold C. Smith, J.P., M.Inst.C.E.; E. G. Stewart; E. B. Tomlinson; the President, the two Vice-Presidents and the Honorary Secretary of the Institution (*ex officio*). *Co-opted:* L. F. Stemp, B.A., LL.B.

Owing to the War certain of the work of the Gas Works Safety Rules Committee has had to be restricted, but on the other hand there have been various questions to consider relating to the safe operation of Gas Works, particularly under War conditions.

The Committee has also continued to review matters pertaining to Air Raid Precautions in relation to the safe operation of Gas Undertakings.

Factories Act, 1937

(*a*) The Committee has co-operated with the Federation of Gas Employers and the Factory Department of the Home Office concerning exemption from the requirements of sub-sections 1(b) and 4 of Section 30 of the Factories Act, 1937, as applied to benzole and ammonia stills.

(i) With regard to sub-section 1(b), the Committee is advised by the Chief Inspector of Factories that an adequate seal of the self-sealing type would provide a satisfactory alternative to the normal type of safety valve and, therefore, such a seal will be accepted as affording compliance with the requirements provided that, in the case of a benzole still, the outlet from the still is piped to a safe place outside any workroom and, in the case of an ammonia still, the outlet is also in a safe place, but not necessarily outside the workroom. There should be no cock or valve between the seal and the still, hence it is necessary that the seal should be of the self-sealing type.

(ii) With regard to sub-section 4, the Committee is informed that the words "so far as the construction of the receiver permits" in reference to the thorough examination, are subject to legal interpretation, but the question whether the lagging should be stripped and the stills dismantled in order to permit the thorough examinations to be made is primarily one for the decision of the competent person in the particular circumstances of each case.

Qualified and competent engineers, acting on behalf of insurance companies, consider that it is generally good practice to ascertain the condition, particularly internally, so far as is practicable and the construction permits, at intervals of about 12 months and to observe as much of the external condition as is practicable at all periodical inspections.

As a matter of routine preparation for examination, the removal of the external lagging is not required; such special preparation is only requested in specific cases where there is evidence of possible deterioration of the pressure portions of the structure.

It will be observed, therefore, that neither removal of lagging nor dismantling of the vessel at the bolted joints is normally necessary, as routine preparation for thorough examination at any regular intervals.

(*b*) The Committee has been consulted in regard to the interpretation of Section 47, sub-section 2(b), of the Factories Act, 1937, concerning the removal of injurious fumes from stationary internal combustion engines. The following interpretation has now been agreed with the Factory Department of the Home Office:

(1) That the Home Office has previously agreed that the strict interpretation of the partitioning off of a gas engine may sometimes involve hardship to occupiers and that it is prepared, therefore, to instruct Inspectors that discretion may be exercised where the cost involved would be a considerable burden and the risk of leakage of injurious fumes into the workroom appears from the construction and position of the engine to be remote, and the Firm can be relied upon, without further visits or warnings from the Inspector, to secure a sufficiently high standard of maintenance to prevent such leakage arising from wear and tear or faulty use of the engine.

(2) When the engine is small and no one is employed near to it except for short periods, and the building is so large that a slight emission of fumes from the engine would not be of any detriment to the health of the employees, a somewhat lower standard of maintenance may be considered reasonable.

(3) That on new installations where the crank-case of the engine is totally enclosed, the Home Office will consider such total enclosure equivalent to partitioning off the engine, provided the crank case breather is:

(i) Led by piping to the outside of the building, or

(ii) connected to the inlet manifold of the engine, in such a manner that it is not possible for the fumes to get into the workshop.

The Home Office has issued instructions to the above effect.

Freezing of Water in Gasholders

During the exceptionally severe weather experienced in the Winter of 1939-40, a number of accidents due to freezing of the water in tanks of spirally-guided gasholders were reported to the Committee. In consequence, a questionnaire was circulated to all Gas Undertakings asking for particulars of all spirally-guided holders with details of any accidents that had occurred.

A review of the replies received shows that accidents due to freezing preponderated in the smaller holders due primarily to the facts that (*a*) the inlet and outlet pipes are nearer the side in the smaller holders so that ice, spreading over the surface from the periphery, takes a shorter time to reach them, and (*b*) the water in the tank of a small holder cools more quickly by losses to the atmosphere than that in a large holder.

The losses, whether by radiation or convection and conduction, are probably the same per unit area of tank wall for both large and small holders, so that the total heat lost in unit time is proportional to the area of the tank whereas the quantity of heat stored in the water is proportional to the volume. It follows, therefore, that the rate of cooling of the holder water is roughly inversely proportional to the diameter of the tank.

The rate of ice formation will be proportional to the difference between the heat lost to the atmosphere and the heat transferred to the periphery from the bulk of the water in the holder. The latter quantity depends on the temperature gradient from the water to the ice and must therefore be greater for the larger holder, so that in this case the rate of ice formation, both on the walls and the surface, will be less.

It is probable that for any given set of severe weather conditions there is a holder water temperature (say, 40°F.) below which freezing is likely to take place. This temperature is less likely to be reached over a limited period of such conditions in a large holder than in a small one. For this reason, where no precautionary measures are taken, a much greater proportion of breakdowns should be expected in the smaller holders.

These conclusions are borne out by the analysis of the results of the questionnaire given in Table I.

In order to ensure no cooling of the holder water, however long the spell of cold weather may be, the rate of steam input to the holder should be at least equivalent to the rate of heat loss from the surfaces. The following examples are based on an atmospheric temperature of 20°F. and holder water temperature initially at 42°F. throughout:

Average rate of heat loss per sq. ft. per hr. through holder wall	34 B.Th.U.
For a holder of 200 ft. dia., tank 30 ft. deep:	
Heat extracted per hr.	640,000 B.Th.U.
Steam required at 1,100 B.Th.U. per lb. total heat	580 lb.
For a holder of 60 ft. dia., tank 20 ft. deep:	
Heat extracted per hr.	130,000 B.Th.U.
Steam required	120 lb.

As a point of interest, the practice of the Gas Light and Coke Company has been to provide 100 to 125 lb. of steam

TABLE 1.—*Summary of Answers to Questionnaire on Accidents to Spirally-Guided Gasholders by Freezing: Winter 1939-40*

Diameter of Gasholder, ft.	Number of Gasholders included in answers received	Accidents by Freezing to Gasholders Fitted with Anti-Freezing Devices	Accidents by Freezing to Gasholders not Fitted with Anti-Freezing Devices	Total Accidents	Accidents to Gasholders as Percentage of Total in each Group
1	2	3	4	5	6
GROUP A:					
10– 20	1	—	—	—	
20– 30	7	—	2	2	
30– 40	18	2	6	8	
40– 50	63 (89)	6	14	20 (30)	33·7
GROUP B:					
50– 60	84	8	7	15	
60– 70	70	12	2	14	
70– 80	35	5	—	5	
80– 90	53	3	1	4	
90–100	19 (261)	2	—	2 (40)	15·3
GROUP C:					
100–110	39	2	1	3	
110–120	21	1	—	1	
120–130	27	—	—	—	
130–140	10	—	1	1	
140–150	7 (104)	—	1	1 (6)	5·8
GROUP D:					
150–160	14	—	—	—	
160–170	5	—	—	—	
170–180	2	—	—	—	
180–190	5	—	—	—	
190–200	2 (28)	—	—	—	Nil
GROUP E:					
200–210	3	—	—	—	
210–220	4	—	—	—	
220–230	1	—	—	—	
230–240	—	—	—	—	
240–250	— (8)	—	—	—	Nil
GROUP F:					
Over 250	1 (1)	—	—	—	Nil
Total	491	41	35	76	

per hr. per injector and to allow one injector for a length of cup or tank water space up to 180 ft., e.g.:

For a 200 ft. dia. holder four injectors would be provided in the tank requiring about 500 lb. of steam per hr. and a similar quantity would be provided for each cup.

For a 60 ft. holder one injector would be provided in the tank requiring 125 lb. of steam per hr. and a similar quantity would be provided for each cup.

The boiler pressure should be some 20 to 30 lb. per sq. in. greater than the static head of the pipe lines to the highest position of the top lift cup so as to ensure that they cannot be logged by condensate.

It is recommended that the procedure which is standard practice in countries such as Canada might with advantage be adopted in this country, i.e., when the atmospheric temperature drops below freezing point the temperature of the holder water is checked and recorded at predetermined intervals.

Attention is also again drawn to precautions which should be taken to prevent anti-freezers from siphoning the sealing water from cups of water-sealed gasholders (*vide* 1st Report of Gas Works Safety Rules Committee, page 2; Communication No. 191, November, 1938).

Wind Stresses on Spirally-Guided Gasholders

The Committee continues to maintain contact with the investigations which are being carried out at the National Physical Laboratory for the Gas Research Board at the suggestion of the Committee, into the action of wind forces on spirally-guided gasholders.

Testing of Gas Works Valves

The Committee again desires to draw attention to the importance of operating all gas works valves at regular intervals to ensure that they are in working order, and it therefore recommends that, if at any Gas Works a regular scheme of operation of valves has not already been instituted, an appropriate scheme should be worked out and put into practice without delay.

Static Electricity

From time to time reports have been received by the Committee relating to sparks produced by striking with a metal instrument on steam pipes and steam-heated vessels painted with aluminium paint. Attention is now drawn to Safety Circular No. 93 issued by the Association of British Chemical Manufacturers, entitled "Aluminium Paint as a Fire Hazard", in which it is stated "The important point is that it is now definitely established that sparks produced in this way can ignite inflammable vapours. Care should be taken accordingly in using aluminium paint on iron or steel pipework or surfaces in places where inflammable vapours are present".

Gasholder Record Sheets

The continued sales of Gasholder Record Sheets show that they are appreciated by the Industry. A new set of record sheets for high-pressure holders has now been issued and copies may be obtained from the Secretary, The Institution of Gas Engineers, 1, Grosvenor Place, London, S.W.1.

JOINT LIGHTING COMMITTEE

The membership of the Joint Lighting Committee is:

Institution Nominees: George Dixon, B.Eng., M.Inst.C.E. (*Chairman*); A. Maurice Bell; W. J. A. Butterfield, M.A., F.I.C.; W. J. G. Davey, B.Sc.; J. E. Davis; E. V. Evans, O.B.E., F.I.C.; J. Weatherall Foreman; A. G. Higgins; A. L. Holton; James Jamieson; Stephen Lacey, B.Sc., M.Inst.C.E.; A. R. McGibbon; C. A. Masterman, M.A., M.I.Mech.E., F.I.C.; F. C. Smith; C. I. Winstone.

Society of British Gas Industries Nominees: W. R. Edgar; Colonel C. J. Falk; F. J. Gould; J. H. G. Horstmann; C. H. A. Kempton; R. J. Rogers; H. R. Stevenson; Philip H. Sugg.

Affiliated District Gas Associations Nominees: James Dickson (North British); E. M. Edwards (Wales and Monmouthshire); E. Howard (Midland); H. W. Saville (Irish); H. Singleton (Manchester); W. S. Stredwick (Southern); J. E. White (North of England); George Wright (Eastern Counties).

Ex officio: The President, the two Vice-Presidents and the Honorary Secretary of the Institution.

The Joint Lighting Committee has continued to review developments and problems relating to lighting by gas, with particular reference to war-time regulations concerning Street Lighting and Lighting in Factories and Workshops. Lighting conditions in general are now governed by Statutory Rules and Orders, 1940, No. 74: "Restrictions on Lighting", published in April, 1940.

The Committee maintains contact with Government Departments concerned with these matters and with the National Illumination Committee of Great Britain, the Illuminating Engineering Society and the Association of Public Lighting Engineers.

Street Lighting

The policy of the Government in the matter of Street Lighting was made clear in a Statement by the Home Secretary (Sir John Anderson) to the House of Commons on 14th December, 1939, and in a letter dated 23rd December, 1939, from the Ministry of Home Security to Local Authorities. These pronouncements, together with a detailed discussion of the requirements laid down, were made available in a Memorandum, which was approved by the Joint Lighting Committee and published by The Institution of Gas Engineers, entitled "War-Time Street Lighting by Gas" (Publication No. 225). It was stated at that time that the Minister of Home Security hoped that the installation of modified street lighting fittings complying with Specification BS/ARP 37 of the British Standards Institution would have a considerable effect in promoting the comfort of the pedestrian and securing safety on the roads and that he trusted that Lighting Authorities would take steps to install them. There has been no subsequent change in the views expressed or regulations made by the Minister in this matter.

Factory Lighting

Owing to the outbreak of war, the recommendations made in the Fourth Report of the Departmental Committee on Lighting in Factories (1938) were not given statutory force. With the longer hours of work in many factories engaged on work of national importance, the Minister of Labour requested the Departmental Committee to review the position. Representatives of the Joint Lighting Committee again gave evidence on behalf of the Gas Industry before the Departmental Committee, which has now issued its Fifth Report on Lighting in Factories.

The recommendations of this Fifth Report are to be implemented in the first place in all factories in which persons are regularly employed for more than 48 working hours a week or in shifts. This will involve, in many instances, the installation of a considerably higher standard of interior illumination than previously and the owners of factories having gas lighting have been informed that advice in this matter may be obtained either from the local Gas Undertaking or on application to the Secretary of the Joint Lighting Committee of The Institution of Gas Engineers. Several of the leading manufacturers of gas lamps have technicians who are capable of giving assistance in this connexion and their co-operation is always available to Gas Undertakings.

The booklet "Light on Industry", issued by the British Commercial Gas Association in collaboration with the Joint

Lighting Committee, has been brought up to date by the further issue of an Addendum entitled "Light on Production", dealing with the recommendations contained in the above-mentioned Fifth Report.

A Conference on Factory Lighting, for the information of H.M. Inspectors of Factories, at which the President of the Institution (Mr. George Dixon, Chairman, Joint Lighting Committee) presided, was held at Gas Industry House on 2nd May, 1940.

A.R.P. Specifications

The British Standards Institution, at the request of the Air Raid Precautions Department of the Ministry of Home Security, has issued a series of BS/ARP Specifications, prepared under the ægis of a Joint Committee of the Illuminating Engineering Society and the Ministry of Home Security (A.R.P. Department). These include Standard Specifications for:

Light-Locks at Entrances to Buildings (BS/ARP 15).
Methods of Providing Even Illumination of Low Intensity (0·002 foot-candle) (BS/ARP 16).
Methods of Providing Even Illumination of Low Intensity (0·02 foot-candle) (BS/ARP 20).
Methods of Providing Even Illumination of Low Intensity (0·2 foot-candle) (BS/ARP 21).
Gauges for Checking Low Values of Illumination (0·002 to 0·2 foot-candle) (BS/ARP 30).
Illuminated and Non-Illuminated A.R.P. Signs (BS/ARP 32).
Illuminated Display Cabinets (BS/ARP 35).
Street Lighting under War-Time Conditions (BS/ARP 37).

Liquor Effluents and Ammonia Committee

The membership of the Liquor Effluents and Ammonia Committee is:

Charles F. Botley, M.Inst.C.E. (*Chairman*); T. Lewis Bailey, Ph.D., F.I.C.; H. T. Calvert, M.B.E., D.Sc., Ph.D., F.I.C.; W. A. Damon, B.Sc., F.I.C.; E. V. Evans, O.B.E., F.I.C.; H. Hollings, D.Sc.; P. N. Langford; P. G. G. Moon, M.Inst.C.E.; A. Parker, D.Sc., F.I.C.; P. Parrish, F.I.C.; E. W. Smith, C.B.E., D.Sc., F.I.C.; J. Wilkinson, O.B.E.; Prof. J. W. Cobb, C.B.E., B.Sc., F.I.C. (*Honorary Secretary*); the President, the two Vice-Presidents and the Honorary Secretary of the Institution (*ex officio*). *Co-opted:* Leslie F. Stemp, B.A., LL.B.

The Liquor Effluents and Ammonia Committee has continued to meet during the year. Dr. Arthur Key (Research Chemist) has been engaged on other investigations at Leeds University, but his services have been available to the Committee when required.

In view of the national importance at the present time of the maximum recovery of ammonia, a confidential Memorandum entitled "Manufacture of Concentrated Gas Liquor (15 per cent) at Small and Medium-Sized Gas Works under Emergency Conditions" (Publication No. 226), prepared by P. Parrish, M.Inst.Gas E., F.I.C., M.I.Chem.E., and approved by the Liquor Effluents and Ammonia Committee, has been published by The Institution of Gas Engineers for the guidance of Gas Undertakings.

The Committee has recommended to the Council of the Institution that a full-scale trial be made of Dr. Key's process for the production of ammonium bicarbonate. This process would provide a war-time alternative to the production of sulphate of ammonia and would assist in the conservation of ammonia. In this connexion consideration has been given to methods of treating the bicarbonate to improve its use as a fertilizer.

In view of war-time conditions, Mr. H. J. Hodsman's process of washing furnace of flue gases with crude or concentrated liquor for the production of ammonium salts suitable for use as a fertilizer has been reconsidered.

The Committee has continued to review and to advise Gas Undertakings and kindred organizations with regard to agreements for the discharge to the public sewers of trade waste effluents and to other matters arising out of the Public Health (Drainage of Trade Premises) Act, 1937.

It is again urged that all Undertakings which may be negotiating with their Local Authority, or which may be approached by their Local Authority in regard to the disposal of their effluent, will consult the Liquor Effluents and Ammonia Committee before concluding any agreement or agreeing to any proposed By-laws under the Act. By so doing it should be possible to obtain for the Gas Industry reasonably uniform terms for the disposal of effluent.

In response to a request received from the Lancashire and District Trade Effluent Committee for the appointment to that Committee of a representative of the Gas Industry, Dr. Key has been nominated and accepted for membership.

Meters Committee

The membership of the Meters Committee is:

John Terrace, M.Inst.C.E. (*Chairman*); H. E. Bennet, M.C.; R. J. H. Clark; C. M. Croft, D.L., J.P., M.Inst.C.E., M.I.Mech.E.; H. W. Hodgson; Stephen Lacey, B.Sc., M.Inst.C.E.; L. F. McLeod, O.B.E.; J. W. McLusky; R. G. Marsh; C. A. Masterman, M.A., M.I.Mech.E., F.I.C.; W. J. Sandeman, J.P.; C. S. Shapley, M.I.Mech.E.; the President, the two Vice-Presidents and the Honorary Secretary of the Institution (*ex officio*).

Attention is drawn to the Paper on "Gas Meters" by John T. Haynes, Assoc.M.Inst.C.E., M.Inst.Gas E. (Communication No. 232), which was to have been presented and discussed at the 77th Annual General Meeting of the Institution in June, 1940. This Paper, with Written Contributions to its Discussion and with the Author's Reply thereto, was published by the Institution and has been widely circulated.

Pipes Committee.

The membership of the Pipes Committee is:

H. J. Escreet, B.Sc.Eng. (*Chairman*); F. Boardman, M.I.Mech.E.; L. F. McLeod, O.B.E.; R. G. Marsh; S. T. S. Musgrove; the President, the two Vice-Presidents and the Honorary Secretary of the Institution (*ex officio*).

The Pipes Committee has continued to meet for the consideration of all matters relating to pipes and problems connected therewith. It invites gas engineers to submit to it any information as to special experiences, tests of new materials or methods relating to pipes so that such information may be reviewed and, if thought fit, made available for the guidance of the Gas Industry.

Factories Act, 1937

A Certificate of Exemption, No. 5 (General), dated August, 1939, has been issued by the Chief Inspector of Factories, exempting from Section 28, sub-section 4, of the Factories Act, 1937, cutting and welding operations on steel or wrought iron gas mains and services.

Light-Weight Tubing

Owing to the need for the strictest economy in the use of iron and steel, normal heavy-weight tubing, steam quality, which has been used by the Gas Industry, will not be made during the period of the war. In its place light-weight steel tubing, that is one gauge lighter than gas quality, will be supplied.

This matter was considered by the Committee in consultation with representatives of the Iron and Steel Control of the Ministry of Supply. Subsequently the Institution circulated a letter to all Gas Undertakings on 9th August, 1940, regarding the use of light-weight tubing, pointing out that tubulars, i.e., connectors, connector bends and the like with parallel threads will be supplied in heavy-weight tubing, and that the adoption of light-weight tubing will reduce appreciably the margin of strength in service pipes, particularly on the screwed portions of the pipe and stressing the need for adequately supporting the pipes and protecting them by troughing. It was particularly emphasized that fitters and service layers should be warned not to cut parallel threads on light-weight tubing.

Air Raid Precautions

The Committee has continued to review matters pertaining to Air Raid Precautions in particular relation to pipes and gas distribution systems. Attention is drawn to a booklet entitled "Notes on Town Gas for Air Raid Wardens", originally prepared by the London Regional Gas Centre, and subsequently revised and reprinted by The Institution of Gas Engineers (Publication No. 227), and to a confidential memorandum on certain effects of air raid damage to gas mains in the London region, submitted by the London Regional Gas Centre and circulated by the Institution to all Gas Undertakings.

Corrosion of Pipes

(*a*) At the request of a member of the Institution, the Committee has examined a wrought iron bend, which had become badly corroded on the outside of the bend, with particular reference to the possible relationship between bending and subsequent corrosion.

The Committee obtained the opinion of experts on corrosion and concluded that it appeared from the present known work on corrosion that, while fatigue of the metal due to straining does not affect its susceptibility to corrosion,

there is a possibility that bending may cause the opening of invisible pores in the metal on the outside of the bend, with the result that corrosion may become localized at that place.

It was further agreed that there is no knowledge regarding the effect of crystal distortion in its relationship to susceptibility to corrosion.

(*b*) The Committee has also considered a report on the examination of a length of mild steel gas main and wrought iron services which have been in use for 30 years.

It was concluded that a large amount of corrosion will occur in any unprotected pipe and that rust is a potential source of trouble, whether it be produced from mild steel or wrought iron. It is very desirable, therefore, that all services should receive protection against corrosion and, with effective protection, there seems no reason why mild steel services should not give satisfactory results.

Fracture of Gas Mains during Periods of Low Temperature

As the result of the severe weather experienced in the Winters of 1938-39 and 1939-40 and the number of cases of fractured mains and service pipes reported, the Pipes Committee has investigated the relationship between the incidence of low temperatures and the fracture of mains and service pipes.

It is known that low temperatures have little effect on the static properties, such as tensile strength, of mild steel and cast iron. On the other hand, when low temperatures occur, if the provision for contraction is insufficient, mild steel will yield under the resulting tensile stresses without cracking, but cast iron will be liable to fracture without appreciable yielding.

Meteorological records for Birmingham, London, Sheffield, and Wisley (Surrey) show that temperatures below freezing point (minimum reading, 31·5°F. on 21st January, 1940) were only recorded at the 1 ft. level at Sheffield and that no temperatures below freezing point were recorded at the 4 ft. level. Readings of temperatures at a depth of 2 ft. were recorded at Wisley, the lowest reading being 34·9°F.

A letter was sent to a number of the larger Gas Undertakings in March, 1940, asking for information concerning:

(i) Number of fractures in a given period per 100 miles of 3 in., 4 in., 6 in., etc., main.
(ii) Relation between the number of fractures per day with the ground temperature at 1 ft. and 4 ft. below the surface.
(iii) Influence on fracturing of the thickness of the pipe wall, of the material and age of the main, and of the extent to which it may have been weakened by corrosion.
(iv) Influence on fracturing of the position of the pipe (in carriageway or footway) and its depth below the surface.
(v) Influence of external mechanical agencies, e.g., ground movement or shock due to traffic.
(vi) Any other special factors influencing liability to fracture of mains.

An analysis of the replies received shows generally that the greatest number of fractures per 100 miles of main occurred in 3-in. mains and that the greatest number of fractures occurred at service connexions. In some cases there appeared to be a close connexion between the number of fractures recorded and ground temperatures at 1 ft. and 4 ft. Little influence on liability to fracture could be attributed to material age or corrosion of mains, position of mains in regard to depth or whether laid under footway or carriageway, and other external agencies.

Any penetration of frost must impose loading on the underlying subsoil as upward expansion is restricted by the solidity of the reinstated surface of the road or pathway and by the rigidity of the frozen upper layer of earth.

The question of fracture of gas mains during periods of low temperatures will continue to receive the consideration of the Committee, which will be glad to receive any further information on this subject.

British Standard Specifications

The following Draft British Standard Specifications have been considered by the Committee:

(*a*) Steel Spigot and Socket Pipes and Specials for Water, Gas and Sewage.
(*b*) Brass Tubes, Tubes for Screwed Glands, and Screwed Glands for Condensers.
(*c*) Asbestos Cement Pressure Pipes of the Standards Association of Australia.

Contributed Communication

A Paper entitled *The Hydraulic Seal in Gasholder Cups* (*Communication No.* 236), by S. M. Milbourne, Assoc.Inst.Gas E., M.I.Struct.E., is published separately. After giving a brief historical account of the principles underlying the development of the hydraulic seal—associated over a hundred years ago with a Patent by Stephen Hutchison describing an hydraulic seal very similar to the cup and dip now in use—the Author gives a mathematical analysis of the operation of the hydraulic seal.

The condition known as "blowing" of the cups is described in detail. The reasons for the failure of the hydraulic seals in the cups of fully inflated lifts, as well as for lifts approaching the uncupping position, are discussed and a description is given of the "blowing" of a cup after a hanging lift has grounded.

Under normal working conditions the lifts and tank of a gasholder may be out of level to some extent, and the effect of this on the cup seals during the cupping and uncupping operation is emphasized. Various methods of improving the working of existing cups and dips are suggested and the investigation is extended to the design of the cup seals of new gasholders.

In some gasholders, cups and dips are subjected to certain restrictions in operation so that oil films may be maintained on the exposed surface of the water in the cups or on the water inside the holder; these conditions are examined and the resulting procedure to be adopted in the design of cups and dips is explained.

The Paper concludes with a description of an apparatus developed by the Author which may be used for investigating the operation of the cups and dips of existing gasholders.

Institution Gas Research Fellowship Report

The publication of the Institution Gas Research Fellowship Report, 1939-40, which deals with the influence of pre-flame combustion on the inflammation of gaseous media, has been temporarily deferred, but it is hoped that the Report will be available early in 1941.

The Institution Gas Research Fellow, J. S. Forsyth, B.Sc., in collaboration with the Corbet Woodall Scholar, D. G. R. Davies, B.Sc., has in the first instance made a systematic investigation of the methods of measuring ignition velocities in aerated burners. The experiments have covered their determination over a wide range of experimental conditions, including variations in tube diameter, rate of mixture feed, mixture composition, and pressure. It has been shown that while the method of determining ignition velocities by measurement of flame surface area and known rate of gas consumption is valid, considerable errors may be invoked by the use of calculations based on either the inner cone height or its angle at a specified radius.

In establishing this criterion for the measurement of ignition velocities, new light has been thrown on the importance of pre-flame combustion; at the same time, the causes of the inaccuracies arising in the alternative procedures have been exposed.

With the aid of information now available, a further attack is being made on the nature of the pre-flame processes in both stationary cones and travelling flames, with a view to the exploration of the probable role of chemical sensitization.

Arthur Duckham Research Fellowship Report

The separately published *2nd Arthur Duckham Research Fellowship Report* (*Communication No.* 237) by E. C. W. Smith, B.Sc. (Research Fellow) deals with the Radiation from Solid Substances under Flame Impact, and describes the results obtained at Leeds University during his first year of tenure of the Fellowship.

The emission of radiant energy from the products of combustion in gas flames represents only a small part of the total energy of combustion; on this account, whenever such an emission is desired, whether for the production of light or radiant heat, it is customary to use as the emitting source a solid body heated by flame impact.

The Report emphasizes that the production of light by means of a thermal radiator heated by a gas flame can never be other than a relatively inefficient process. If a high efficiency is ever to be attained the production of luminescent radiation is essential, and the possibility of this is discussed in the light of recent developments in physics and chemistry. The conclusions of previous workers have been tested experimentally, and the results are reviewed critically.

The luminescence observed from surfaces in contact with flame at temperatures below incandescence is described. Many new luminescent substances have been discovered and the importance of the proportion of the activator is made clear. The essentials of the mode of supporting the substances for maximum light efficiency are discussed and the spectroscopic examination of the light emitted by luminescent substances is described.

WARTIME STREET LIGHTING*

A STUDY OF FUNDAMENTAL REQUIREMENTS

THIS study is concerned with the behaviour of the eye at very low illuminations, on which any effort to satisfy the needs of the man in the street during the night time is necessarily based.

The human eye is capable of adjusting itself to very wide variations in degrees of brightness. The illumination received from summer sunlight on a clear day may attain 10,000 ft.c., whilst the value derived from faint starlight may be of the order of 1/10,000th ft.c.—a range of about one hundred millions to one. The brightness of objects viewed by the eye undergoes correspondingly great variations.

This discussion is devoted to vision at the lowest levels in this range of illumination which in practice is all that is available out of doors on a clear moonless night, and is of the same order as that furnished by wartime street lighting.

Behaviour of the Eye in Weak Light

The behaviour of the human eye, operating at low illuminations of the order of a thousandth of a foot-candle affords a natural starting point for this investigation. The conditions characteristic of " scotopic " or " twilight " vision are familiar to physiologists. These may be broadly summarized as follows :

(1) The condition of complete dark-adaptation, which enables fullest possible use to be made of the feeble light afforded, is only slowly attained by an eye previously adapted to normal illuminations. Certainly in the case of a person emerging from a brightly lighted room into a dark street some minutes must elapse before the eye can " take in " its surroundings with any certainty, and 30 minutes is a reasonable time to allow for full adaptation. Moreover, while such adaptation is only gained slowly it can be very quickly destroyed. Momentary exposure of the eye to a bright flash of light, or quite a brief gaze at a surface of normal brightness, will partly undo the results of a long period of waiting. Even apparently normal persons differ much in their speed of adaptation. Some, more particularly elderly people, approach the condition of " night blindness " and always find great difficulty in finding their way in semi-darkness.

(2) Near the centre of the retina is a small depression, the " fovea centralis," where at normal illuminations vision is most acute. It is this area which is normally exercised in the recognition of form. At the low order of brightness characteristics of twilight vision this area is relatively insensitive compared with the surrounding regions. The same is true, in somewhat less degree, of a larger area, surrounding the fovea, known as the " yellow spot."

In twilight vision two consequences follow :

(i) Objects are no longer perceived by direct vision, but " out of the tail of the eye."

(ii) The outlines of objects are never seen with the same clarity as by normal vision ; they tend to appear as masses, limits of which are less clearly defined.

(3) At the low order of illumination characteristic of twilight vision colours can no longer be distinguished. In Sir William Abney's classic experiments it was found that the perception of the colour of spectrum yellow ceased at an illumination somewhat under 0.002 ft.c., though the limit is lower for green or blue light. It may safely be inferred that the colour-sense has been so weakened as to become practically inoperative at illuminations of the order of thousandths of a foot-candle.

Visual Sensitivity at Low Levels of Illumination

Consideration in turn of these three characteristics of the dark adapted eye leads us to a number of general principles on the observance of which visual sensitivity depends.

It is evident, in the first place, that the provision of even a weak degree of general illumination helps to shorten the period of adaptation and renders the change in condition of the eye less extreme. It also serves a beneficial purpose in fixing the order of brightness to which the eye must adjust itself, and, in this respect, has a certain stabilizing influence. It is common experience that the eye, when adapted to full daylight, is in a very steady condition, and only the sudden appearance of an object of surpassing brightness can materially disturb its powers of perception. At the other extreme we have the state of complete dark adaptation, attained by the eye after prolonged experience of complete darkness, leading to extreme sensitiveness. The display of even the faintest light may then disturb the condition of the eye and impair its power of perception. When exposed to a certain illumination—even if only of a low order—the hyper-sensitiveness of the eye is less marked and the effect of exposure to an object of moderate brightness less severe.

From (1) it may be concluded that the first essential is to abstain from any action liable to impair sensitiveness of the retina. By this is meant not merely that extreme conditions of dazzle creating momentary semi-blindness must be avoided. It is also necessary to avoid any condition of excessive contrast, such as may depress the action of the eye and prevent it getting the full value of the weak illumination available.

The eye should, therefore, be " nursed " during its passage from normal brightness to comparative obscurity, and care should be taken to ensure, so far as possible, the absence from the field of view of any objects of undue brightness such as exercise a depressing effect on vision.

As a guide in connexion with this problem new standards are necessary. Some indication of the conditions desirable at normal illuminations, say, about 0.5 ft.c., is afforded by the familiar recommendations that within the direct range of vision (*a*) the brightness of no object should exceed 5 candles per sq. in., and that (*b*) the variation in brightness of objects within this range should not exceed 100 : 1.

There is ground for the belief that as the general range of brightness rises the absolute limit to brightness may also be increased, while the limiting ratio requires some reduction. The tendency for these two factors would presumably be in the opposite direction when very low orders of brightness are concerned. As, however, there is little positive information available on this point, we might, as a first approximation, apply the above rules to conditions met with in areas receiving an illumination of 0.0002 ft.c. Application of the rule quoted above would then give a limiting brightness of 0.0002 candles per sq. in., roughly equivalent to 0.1 equivalent foot-candles. Adoption of the 100 to 1 ratio, on the other hand, would give a brightness of about one-fifth of this—namely 0.02 e.ft.c.*

Under the conditions affecting the powers of perception of the eyes at this very low level of illumination, the central region of the eye, the " yellow spot," where perception of form is mainly accomplished at normal illuminations, is relatively insensitive. Seeing is effected by the peripheral region of the retina, where perception of form is less acute. It cannot, therefore, readily recognize details or distinguish objects at a distance, and can only see the broad shapes of things at close quarters. For one thing, the image of an object subtending at the eye angle less than 2° to 3° is liable to fall inside the yellow spot, when it becomes invisible. Objects of this size cannot be seen with certainty. They " appear and disappear " as one is looking at them.

Another closely related factor is the association of size and brightness. At normal illuminations two objects of the same physical brightness, but differing in area, still have the same brightness. Under a given illumination a half-crown is no brighter than a threepenny-bit. But at very weak illuminations this is not necessarily the case. Impressions may depend upon the product of area and brightness. Larger objects appear brighter than small ones, which again enhances their visibility.

Another factor of vital importance is the ratio of brightness between object and its background. At high illuminations, under very favourable conditions, a difference in brightness of only 1 to 2% can be detected. It may be doubted whether, under such conditions as we are considering, a difference of 20 or even 30% can be detected with certainty—for example, an object of quite substantial size which reflects only 20% less or more than the adjacent roadway and receives an illumination of only 0.0002 ft.c. might quite easily escape recognition.

In order to ensure that an object may be visible to people in the street at a certain distance it is therefore expedient (i) to

* From a Paper prepared for the Joint Lighting Committee of the Ministry of Home Security and the Illuminating Engineering Society. Presented at a Meeting of the Illuminating Engineering Society on Dec. 10.

* In giving these values it is assumed that the bright object is located with the street as a background. With brighter backgrounds different conditions would apply.

ensure, if possible, that the angle subtended at the eye is well outside 3′ ; (ii) to secure a relatively high contrast with its background, and at the same time (iii) to guard against the possibility of depressing vision by *excessive contrast*, so great as to approach glare conditions, such as arises when objects of relatively high brightness are within the field of view.

When the amount of light available is relatively small the importance of avoiding casual losses is correspondingly great. A loss, through deterioration in transmission or reflection, of, say, 10 or 20% has a much more serious effect on vision and on amenities generally than would be the case when the illumination and the resultant brightness are relatively high. Not only, therefore, should lighting appliances, such as those used for street lighting, be maintained in good condition, but care should be devoted to all relevant factors such as the cleanliness of wind-screens of motor vehicles, to the upkeep of surfaces treated with white paint, &c., in order to render them more visible by night.

There remains the question of colour, referred to under (3) above. Under this heading there is not a great deal to be said, except to recall the practical consequences of the physiological phenomena mentioned. One obvious conclusion is that it is of no use, at a very low order of brightness, to rely on colour as a means of distinction, since colour as such can no longer be distinguished. It is also well to recall the rapid loss in sensitiveness to red at weak illuminations—with the result that a red object, such as a pillar box, becomes in effect black and indistinguishable from a dark background. Objects desired to stand out from their dark surroundings at low illuminations, and which are identified by their colour under normal conditions, should preferably be painted green or blue. While the sensitiveness of the eye to blue light is accentuated at very low illuminations, experience has shown that the use of such light, in preference to white light, is not advantageous. The general use of pure blue light involves considerable absorption, and is therefore uneconomical, and for some purposes it is considered inexpedient owing to certain loss in sharpness of outline of objects illuminated when viewed from some little distance away.

Applications

In what follows an attempt will be made to apply some of the principles outlined above to conditions such as are experienced on dark nights, and in particular to wartime street lighting, which furnishes an illumination of the order of 0.0002 ft.c.

It has been pointed out that the utility of this low order of illumination depends entirely on the avoidance of factors liable to depress visual sensitivity. As a first step it is desirable to do everything possible to facilitate the transition from the brightness indoors to the relative obscurity outside.

Light traps, besides their primary object of preventing escape of light from within, have a secondary field of utility—in providing a period of adaptation. If there were a general understanding that behind each entrance of the street there should be a short passage or ante-room where the illumination was graduated by steps from the full illumination inside (say, 3–5 ft.c.) down to, say, 0.02 ft.c. at the threshold where, if possible, they should linger for a short time, the final transition down to 1/10,000th or less of the original illumination would be rendered easier and the period of subsequent adaptation shortened. In any case, a wait of a few minutes is desirable before movement is made.

The next step is to avoid the presence of objects of undue brightness out of doors. Here we encounter the familiar difficulty that the requirements of different classes of users may not be the same. Conditions which satisfy the needs of persons on foot may also prove of some benefit to drivers of motor vehicles. But the latter have other requirements—based mainly on their need to see objects at greater distances. Headlights and traffic control signals, the power of which is necessarily fixed at a value far exceeding that necessary for the recognition of objects at short range, inevitably give rise to some degree of glare. In both cases, however, control of the beam and the adoption of screens and masks does much to mitigate the trouble. It is chiefly when regulations are disregarded that serious glare is liable to arise.

Seeing that " brightness " is a fundamental characteristic of all forms of direction and display signs and other objects designed to attract attention, there is an evident need for simple " brightness-meters " adapted to the testing of these exceptionally low values. The absence, until recently, of such devices (now specified in BS/ARP 30) goes far to explain the tendency for specified values to be exceeded in practice.

For all classes of users, however, the presence of unduly bright objects in the field of view is a drawback. Indications of limiting brightness have been quoted above. It is no doubt arguable that at this low level of illumination considerably higher values might be permitted without detriment to vision. It is, however, interesting to observe that the first of these values (0.1 e.ft.c.) is the maximum assigned to illuminated A.R.P. signs (BS/ARP 32) as a result of long and continued and careful experimental investigation, whilst the second is exactly that specified in the Lighting Restriction Order as the limiting brightness of illuminated display signs. Hence there seems good ground for the adoption of a value of brightness of the order of 0.05 *to* 0.1 *e.ft.c.* as a limit in streets—especially as these limits have been independently determined with a view to restricting conspicuousness from the air.

The theory outlined under these headings has an obvious bearing on road amenities and safety. Under conditions of twilight vision many assumptions commonly made in regard to safety of traffic no longer apply. It has been shown that a degree of contrast much beyond that ordinarily sufficient may be necessary in order to enable even objects of substantial size to be seen. The images of objects subtending less than about 3′ at the eye are liable to be received on the insensitive area and escape notice. Now 3′ represents about 2½ ft. at a distance of 60 ft. It is, therefore, expedient that obstructions should be illuminated over an area having at least this linear dimension. This sets a new limit to the distance at which objects are visible. The study of these conditions should therefore form an essential part of any scientific enquiry into the origin and avoidance of traffic fatalities.

At the value of illumination prescribed for wartime street lighting it is desirable to increase the available brightness whenever it is expedient to do so. By selecting materials of high reflecting power we may sometimes achieve results as good as if ten times the illumination on a relatively dark material were provided.

The area of darkest tone commonly met with in the street is the road surface. A city pavement, in general, comes conveniently about mid-way between this and white paint, and therefore affords a moderately good background both for the figures of persons in dark clothing and for obstacles treated with this material. White paint used with discretion at busy crossings enables persons crossing the roadway to be more easily seen. It is evident, however, that this treatment could not be applied on a large scale to road surfaces and pavements. Otherwise we should be providing conditions equivalent to an illumination perhaps ten times as great as the minimum sanctioned.

On vertical surfaces such as walls and railings, &c., the advantages of white or light grey have been obvious. The extensive whitening of the kerb both on the horizontal and for drivers of vehicles and persons on the other side of the road, the value of the whitening of the vertical surfaces of kerbs has proved itself.

The application of white paint to motor vehicles is similarly useful, but in order to get the full value of this device it is expedient that it should be applied to a much greater area than is at present usual.

Besides the primary need of observing relatively big objects—*e.g.*, bodies of persons at close quarters so as to avoid collision, contrasts in brightness play an important part in creating a sense of perspective and enabling people to " size up " their position. Occasional lightening of familiar objects, such as the outlines of entrances to buildings, so that they " show up," is helpful in this respect.

It has sometimes been suggested that the escape of a small amount of light at angles very slightly below the horizontal is a valuable feature of wartime street lighting units, because it enables the sources to serve as beacons, marking out the way. Theory, however, would indicate that for the ordinary user of the roadway the comparatively high brightness of such visible light would tend in some degree to depress vision—at least in the case of sources mounted at the lower levels (10 and 15 ft.). There is perhaps more force in the suggestion from the standpoint of the driver of a motor vehicle who has a bright light from his headlamps. Yet it would seem that, even in this case, the need might be more readily met by other means.

There have been suggestions in regard to various forms of local lighting (for example, restricted beams of light at comparatively high levels of intensity at crossings, &c.) as an alleviation of the blackout. While such devices may have a certain value as supplements to the existing system of wartime street lighting, they scarcely offer a satisfactory alternative, and may more easily determine disabilities. Experience seems to have proved the fundamental soundness of the belief that the groundwork of any effort to improve amenities in darkened streets must be the provision of a uniform level of illumination with, so far as possible, no regions of complete darkness, and if necessary with some regions slightly higher than others. The impression

produced when wartime street lighting is applied uniformly over a large area is so much stronger than that of a few units in a single street.

There can be no question but that the measure of illumination such as is provided by wartime street lighting, though so small, is of appreciable benefit, especially when applied on a large scale. It affords a ground work on which the eye can build up impressions from any extra casual light it may receive, much more successfully than if they occurred in total darkness.

It would, however, add to amenities in the streets if somewhat higher illuminations, under proper control, or suitably screened, could be adopted *locally* in certain instances. Although the aid obtainable from the contrast is substantial, there are limits to the possible gain. The darkest material likely to be available would hardly reflect less light than 5%, and the lightest, such as white paint, not more than about 80%. In so far, therefore, as one relies on difference in reflecting power to produce contrast the maximum possible ratio in brightness is about 15 : 1. If the ratio is increased beyond these limits, as, for example, by using self-luminous objects (such as signs illuminated within), a further gain in visibility is possible—especially for the more distant objects, until we approach a point, probably well above the value of 0.1 e.ft.c. noted previously, where the brightness begins to interfere with the state of dark adaptation of the eye and to depress the level of visibility of surrounding areas.

Various applications of this principle could be suggested.

INDUSTRIAL GAS LIGHTING IN LANCASHIRE*

By H. PEGG,

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IN presenting this Paper I do not claim any originality of methods in dealing with the important subject of gas lighting in factories in Burnley. I wish to explain a few simple facts, the knowledge of which has assisted me considerably when dealing with people who are sceptical of the value of gas lighting.

Many of my colleagues who happen to read this may smile at the boldness of classing gas lighting as being still a subject of importance in 1940. Unfortunately there are many in the Industry who are indifferent to the lighting load, except perhaps the requirements for street lighting. It is generally accepted that street lighting is worth fighting for, and every effort is being made by manufacturers constantly to improve the lamps and fittings, and reach a high standard of efficiency. This progress has been momentarily halted due to the war, and we must appreciate their efforts in so rapidly producing such effective A.R.P. fittings for the new requirements of restricted lighting. But restricted lighting should be confined to street lighting as a war measure, and we should see that restricted lighting is not allowed to remain in industry.

In Lancashire we have as a staple industry the various forms of cotton preparation and weaving, an industry which we know has had more than its share of bad times, thus providing an excellent excuse for not meeting the requirements of the Factory Acts. As conditions now existing in many of the cotton mills date back to about 1870, some mention should be made of the early history of the gas burner. By the courtesy of Messrs. Geo. Bray & Co., Ltd., we have the opportunity of examining a selection of historic flat flame burners, and observing the progress made from 1865 until the introduction of the incandescent burner.

In those good old days the chief difficulty in lighting installations was to keep a constant and low enough pressure to maintain a steady and quiet light. The introduction of the Bronner burner was the first serious attempt at methodically controlling the consumption. A steatite disc on the burner inlet was pierced with holes, the total area of which was less than the area of the outlet slit. In this manner the pressure was restricted from a recognized inlet pressure of 0.3 in. down to 0.03 in. at the point of combustion. The success of this burner was due to the extreme care and accuracy maintained throughout its construction. In dealing with these pressures, friction losses of the pipes did not seriously enter into their calculations, and usually the minimum sizes of pipes were used as a matter of economy.

Following close on the Bronner burner was the governor type burner, and it was in those early days of lighting that William Sugg realized the importance of constant pressure and volume. It is rather disappointing to realize that so early in the history of lighting, the Industry had put before it a principle so essential to good lighting which was not accepted as a standard.

At this period the designers made rapid progress with burners which gave increased candle-power, but in producing something " good and cheap " they set the Gas Industry the task of teaching the public the difference between the so-called " good cheap burner " and a reliable efficient burner.

Design of Burners

In the designing of burners, history repeated itself, as, after the introduction of incandescent lighting, the people requiring a reliable burner could be supplied with one incorporating a constant pressure governor with fixed gas and air injector, but this type of burner was apt to be a little more difficult for the salesman. To be satisfactory, the conditions under which it was fixed had to be known. The makers would supply a burner with a nipple of suitable size, according to the C.V. of the gas, and at a pressure of 2 in. W.G., but it was up to the salesman to be certain there was a minimum pressure of 2 in. wherever the burner was to be fixed. With the lower pressures carried in the gas mains at this period, and the small size of internal fittings, it was a doubtful proposition without making a test as to whether this type of burner would be satisfactory.

In consequence the adjustable burner became popular ; it was easy for the salesman to demonstrate, in fact so easy it didn't need a plumber, gasfitter, or gas salesman to tell of its merits. It could be purchased from any ironmonger whose only experience of lighting was selling lamp oil. I am confident that this so-called simplicity or ease of adjustment to gas of varying quality and pressure has contributed considerably to our present position regarding domestic lighting, but for industrial lighting we still have the opportunity of proving our worth if sufficient trouble is taken.

On the introduction of upright burners in the cotton mills it was generally found that the pressure drop was considerable, and that it was difficult to entrain a sufficient volume of air, due to the low velocity of the gas. Experiments proved that increased candle-power could be obtained by boosting the pressure, and it became the recognized practice to have a compressor fitted on the gas supply usually set to increase the pressure to 8 in. W.G.

This was satisfactory under the conditions, as it improved the aeration so desirable for the long upright mantle, but the compressor idea became an obsession and was continued even when inverted burners became common. I find that managers of many cotton mills are still astonished at the idea of scrapping the compressors and installing low-pressure lighting, but wherever this is possible it cannot be too strongly recommended.

Where a compressor was installed it was usual to find a fixed nipple burner, but to-day one can find both types of burner in one mill, and in many cases a variety of designs. The burners of fixed nipple type have, in many cases, had the holes in the nipples enlarged because the compressor has failed to compress any longer. Only a small percentage of mills have brought their lighting to conform to the recommendations of Factory Lighting Acts, and there appears to have been some reluctance to comply with these recommendations, but now that everyone has been told to " go to it ! " and the cotton industry is an essential part of the war machine, there seems to be no further excuse for delay. The time is opportune for us to show what can be done. Before doing so we must stop and just study things over a little, and perhaps benefit by the mistakes of others.

What we must offer is a burner capable of giving a maximum luminosity for a minimum consumption, and sufficiently reliable to maintain this condition throughout the lighting season. To maintain a good light the two essentials are the correct amount and the correct mixing of the gas and air. " Just enough " is nearest the ideal. Any more does not increase the light ; apart from the unnecessary wastage of gas it tends to increase wear

* Paper to the North-East Lancashire Industrial Gas Discussion Group.

and tear of the burner due to extra cleaning, with a considerable increase in mantle replacement. Experiments and tests carried out in conjunction with our Street Lighting Superintendent have proved that this ideal cannot be maintained with the adjustable type of burner. There are three main reasons : (1) The human element : no man, however good, can go from burner to burner regulating them, and be certain that they are all regulated correctly. (2) Assuming this could be done, the result would be upset when the pressure of gas varied. (3) In regulating the amount of gas to pass the nipple the needle enters the orifice, and as it checks so does it break up the even jet of gas, thus preventing the correct entrainment of air for the best mixture. (The correct amount of air is drawn in when the flow of gas is as an even jet passing to the centre of the venturi.)

It can be understood that if the regulating needle does not enter the orifice absolutely true the flow of gas becomes broken up and either impinges on part of the venturi walls or the jet spreads, and instead of drawing in the maximum amount of air it has a tendency to choke in the venturi. This will be better understood if one realizes that a stream of gas with an initial pressure of 3 in. W.G. issuing from such an orifice will rush across the air ports at a high velocity of about 160 ft. per second.

Gas Lighting in a Textile Mill.

Even if a nipple is absolutely true, considerable friction is caused in the venturi tube by the gas stream rubbing against the air and so giving it momentum to pass along with the gas through the narrower neck of the venturi.

Having in mind the disadvantages of the adjustable burner and the essentials of a reliable burner, we decided to cut out the human element and the mechanical faults at the same time by adopting the fixed nipple system. Before deciding on a suitable nipple numerous tests were made, and it was found that if the nipple orifice was tapered to a fine edge there was better entrainment of air than if the nipple had a tubular bore.

A series of this type of nipple was obtained of various capacities, increasing in range by a ¼ cu.ft., each nipple being fitted to an identical 2-lt. medium superheated burner. With the gas governed to 3 in. W.G. photometer tests were made, from which it was proved that up to 75% of unnecessary gas can be used without impairing the immediate efficiency of the light. By these tests two things were settled—*viz.*, the minimum size of nipple for the maximum light, and the pressure required for that particular nipple. The value of the superheater was also proved, after finding the minimum size of nipple, and it was found that from lighting the burner when cold to becoming fully pre-heated there was an increase of 25% in the photometer reading. The next question was, " What do these figures represent to our consumers ? " Numerous mills in our area were using the adjustable 1-lt. medium burner with a recognized consumption of 2.75 cu.ft. per hour. As already mentioned, up to 75% excessive gas may be passing through the burner, so, allowing a conservative estimate of 30% wastage due to faulty regulation, this gives an hourly consumption of 3.5 cu.ft. per 55 c.p. burner. Against this we can offer a 125 c.p. burner with a net consumption of 4.5 cu.ft. This is surely something very acceptable ; for an increase of approximately 25% in gas consumption there is an increase of more than double the candle-power. Even if the universal burner is being used we can definitely reduce the gas consumption and give them an increased candle-power of 25%.

Importance of Constant Pressure

We were now satisfied that we had something good to offer, and some simple facts which should be convincing. It was, of course, necessary to take care when offering the burner to be sure of a constant pressure throughout the mill, and to decide quickly which type of burner to offer, (*a*) the high pressure, involving the continued use of the compressor, or (*b*) the possibility of removing the compressor and using low-pressure burners.

This knowledge can sometimes be obtained with a few simple questions. If turning off the compressor makes little difference to the lights, or even if they go down to half mantle, it is fairly safe to assume that the compressor can be taken out and a constant pressure governor fixed on the outlet of the meter. If the burners almost go out when the compressor stops, it is advisable, before discussing the matter at length, to examine the back pressure flap valve, generally situated in the compressor, to see if it stuck in a position which will restrict the flow of gas. Should the valve be found to open freely it is advisable to find the average consumption per burner without the compressor running, which may often prove to be as low as 2 cu.ft. per hour. In this case the type of burner used can only be determined after a test of the fittings, which would have to be made in any case before a quotation could be given. To make this test I usually increase the consumption equivalent to an average of 4.5 cu.ft. per burner by taking off the burners at the extreme end of each pipe line and opening the taps until the desired total consumption is obtained. This is followed by six or eight pressure tests at what may be considered the worst positions. Providing there is a minimum pressure of 3 in. W.G. it is safe to offer low pressure lighting, but where the pressure is below this it is advisable to continue with the use of the compressor and to offer suitable burners.

Having confidence in the low-pressure fixed nipple type of burner, and with the knowledge gained in these early tests, I well remember my first attempt at selling this burner. I heard of a mill where the workpeople were dissatisfied, and found they had a compressor in use with the adjustable universal burner. I offered to fix sample burners, which proved very satisfactory, but I had difficulty in convincing the manager that the same brilliance could be obtained without the compressor. I don't know whether it was the sales talk, the confidence I

showed in offering the burner, or the samples fitted, but within a week of first approaching the mill I was given the order to re-light the mill as we thought best, and to make the burners uniform in height and alignment. Before taking out the compressor we removed the old burners and cleared the pipe lines by hammering them and then blowing them clear by means of the compressor. A governor was fixed on the meter outlet, set for a pressure of 3 in. W.G., and 2-lt. medium superheated burners were fitted complete with dust traps to protect the fixed nipples, and a dust shield over the air ports. The day of lighting these burners was looked forward to, and the immediate results were well worth the effort. Everyone was delighted, the manager went singing the praises of his gas lighting to his friends on the cotton exchange, which immediately brought us further inquiries and orders. The workpeople asked if they could buy similar burners for their homes.

Design of Dust Shields

The average luminosity at working level was 7.1 ft.-candle, and at the mean point on the floor was 1.3 ft.-candle. We left this job feeling that good business was ours for the asking, and you can perhaps imagine my surprise to learn in three weeks' time that the burners had lost that brilliance which they had when first lighted. On investigation we found the dust shields at fault. It was evident that with all the care and forethought given, this job was a flop. One of the essentials had not been adhered to ; the correct amount of air had been upset by the dirty atmosphere. This was an unforeseen obstacle which had to be overcome. It was obvious the dust shield now fitted was useless ; it was designed on the principle of an inverted cup. The dust and cotton fibres which float about in the atmosphere of the mill had not reached the air ports, but had formed in a kind of felt ring round the bottom of the shield and so checked the air intake. I immediately investigated what had been done before to overcome this difficulty, but could find nothing very satisfactory. Several attempts had been made by different manufacturers, with varying degrees of success.

We immediately took off all the dust shields, and again obtained that final brilliance of the mantle, but we knew this could not last for long if the cotton fluff had to be burned along with the air-gas mixture. We appealed to the makers of the burner to produce a suitable shield to meet the conditions, and several unsatisfactory attempts were made. Finally I designed a shield and put it to a very severe test. A quantity of the cotton dust was repeatedly disturbed around the burner, the quantity being far in excess of what may be expected under normal conditions, and when the burner, shade, and top of the dust shield were coated with a thick layer of fluff, the light itself was not affected.

This shield was subsequently adopted as most suitable, and was produced for us by the burner manufacturers under the name of the Burnley Dust Shield. We fitted them throughout the mill, and from then on our troubles in this mill were over. We realized that we had a genuine, reliable burner which would " stay put " even under adverse conditions. This was later proved by the fact that these burners were never stripped for cleaning during the first three years of use. The manager considered them satisfactory, and would not permit us to touch them. Another noticeable feature was the life of the mantle ; in three years the mantle account was down by over 60%.

A Difficult Case

The best reward for doing something well is to be given more to do, and this first installation was followed by plenty of hard work ; and although we had an excellent example to quote, each manager in turn had to be convinced that the same could be done in his mill. In subsequent installations we experienced very little trouble beyond the routine work already described, but nothing worth while is ever achieved without some phase of difficulty, and we certainly had one case which made up for the rest. In this case the burners very soon lost their brilliance, and inspection again revealed the trouble to be due to the cotton fluff. The brass gauze on the sides of the dust shield had become coated, and the air intake was being seriously checked. Normally the fluff would gradually build up and, becoming too heavy to adhere to the gauze, would drop on to the burner top and become scorched. We analysed this fluff, and it was found to be of cotton fibres, china clay, and a resinous substance. Here we had the explanation for the dust sticking to the shield, and careful inquiries showed that the trouble was due to the excessively humid atmosphere in the mill, and very heavy " sizing " of the cloth. We have tried various means of overcoming this difficulty, without success, and finally reached an agreement with the management to clean the burners at a monthly interval throughout the lighting season. I am now convinced that nothing will give continued reliability in this case only the installation of an air-gas mixer and suitable burners for this system of lighting.

I may say her ethat wherever initial cost is of secondary importance we straightaway recommend this type of installation, as it conforms to all the essentials previously related, with the decided advantage of mixing clean air with the gas.

Unfortunately, the majority of consumers consider initial cost at the expense of efficiency, which has compelled us to find a good substitute, and has given me some excuse for writing this paper. We find even now that our recommendations of the fixed nipple system are not always accepted because of the comparatively small expense of installing a constant pressure governor on the meter outlet. In these cases we supply the same type of burner, but with the regulator, on the understanding that the regulator can be changed for the fixed nipple at a small cost when they have realized their mistake. One firm has already changed over in this manner.

Generally speaking the fixed nipple type burner has given satisfaction. We have had complaints of odd burners here and there not being so good, and have found the nipple orifice has been opened (whether intentionally or not was never proved). To overcome this possibility we now supply steatite nipples which will break at the first attempt to reamer. For cleaning the nipples we always recommend the use of a sharpened pegwood stick, which cleans and polishes the orifice without damaging.

Every effort has been made to make the burner foolproof, and one is apt to feel disgusted at some of the shoddy burners which are still being offered direct to the mills by some of the lesser known lighting contractors. It is well to remember your competitor may cut you in price, but if you are selling personal service he is certainly up against it. Other competitors are always awaiting the opportunity to instal other forms of lighting, and we are all well aware of the serious consequences of indifference.

In Burnley we are determined the lighting load shall not fall into the realms of the forgotten ; what is left of domestic lighting we shall try to hold by continued free maintenance service. In industrial lighting we have every reason to feel confident of the continuance of that valuable load. In the 82 mills supplied by gas out of a possible 89 in our area, we have a total annual consumption of 23½ million cu.ft. of gas. In 15 of the mills we have already fitted 3,000 of the burners I have described, with suitable shades to prevent glare, and we know the majority of the remainder are just waiting for a reminder from the powers that be that the avoidance of glare became law from Jan. 1, 1939. The standard of lighting recommended by the Departmental Committee on Lighting in Factories in their fourth report was for a minimum average of 4 ft.-candles at the working level for this class of work. The recommendation from The Institution of Gas Engineers was that 5 ft.-candles was a reasonable average. It can therefore be considered as safe in recommending the 2-lt. burners, if they are spaced at a minimum of one burner to four looms.

Street Lighting

Regarding street lighting, our Street Lighting Superintendent is no less alive to the requirements of this important branch of lighting, and he has been responsible for the conversion of over 3,000 lamps to the fixed nipple system. In all we have a total of 4,231 clock-controlled lamps in our area of supply, and surely this speaks well for the efficiency of gas for street lighting, especially if compared with our competitors, who have less than 200 lamps fitted. In normal times one pleasing feature of Burnley street lighting is that all back streets are suitably lighted, and this gives a uniformity of lighting which has been still more evident since the introduction of fixed nipples.

Normally the annual street lighting load is 111 million cu.ft., with a further 2¾ millions for the 154 lamps fitted for exterior shop lighting. The bulk of this valuable load has been temporarily lost, but I think Burnley can compare favourably with many of the larger undertakings in meeting the requirements of restricted lighting. The war-time lighting fittings have been fitted to all lamps on the main roads, bus routes, and important thoroughfares, and we now have 1,369 B.S.I. fittings in use, with a further 100 A.R.P. directional signs, which means a wartime consumption of 25¾ million cu.ft. per annum.

There is a saying that more businesses break down through inside weaknesses than by competition ; how true this is of the gas lighting of yesterday ! But what of the gas lighting of tomorrow ? Experience is of little value unless it teaches how to improve, so let us be worthy of all the hours of study and labour the numerous inventors have given in perfecting the gas burner, by not just " selling " our next burner, but by giving that personal service necessary to make sure we have sold something reliable.

Recovery of Salts in Gas Purification

A patent taken out by the Gas Light & Coke Company, W. K. Hutchison, G. U. Hopton, and I. G. C. Dryden (No. 526,492 ; application date, March 17, 1939) relates to the recovery of salts from solutions used for gas purification. It has particular reference to the recovery of salts, including potassium thiocyanate and potassium ferrocyanide from the potash solutions employed for the purification of gases containing carbon dioxide, hydrogen sulphide, and hydrocyanic acid.

When an alkaline solution such as aqueous potash is circulated in contact with crude coal gas part of the alkali forms neutral salts such as potassium thiocyanate and potassium ferrocyanide, and the fixation of alkali in this way leads to a reduction in the capacity of the solution to absorb hydrogen sulphide. In practice more alkali must be added in order to maintain the absorptive capacity. Further, the increase in the total concentration of alkaline salts in the solution leads to a reduction in the solubility of each of them, and in order to avoid deposition of solid a portion of the solution must be withdrawn from time to time and replaced by a solution of the alkali. The loss of alkali—*e.g.*, potash—due to formation of thiocyanate and ferrocyanide and the loss of alkali in the discarded solution constitute a serious increase in the cost of purifying the gas.

An object of the invention is to reduce the cost of purifying gas by recovering the alkali salts formed in the washing liquor, and to separate from the discarded washing liquor potassium thiocyanate, potassium ferrocyanide, and potassium carbonate.

It has been found that the factors which determine the maximum permissible concentrations of fixed salts in the gas-washing solution are the solubility of potassium bicarbonate in the presence of potassium carbonate, potassium ferrocyanide and potassium thiocyanate, and the solubility of potassium ferrocyanide in the presence of potassium carbonate, potassium bicarbonate, and potassium thiocyanate. In a normal method of washing coal gas the limiting concentrations of salts in the washing liquor have been found to be :

Potash . . .	13.8% as K_2CO_3
Thiocyanate . .	9.5% as KCNS
Ferrocyanide . .	4.5% as $K_4Fe(CN)_6$

At this stage potassium ferrocyanide begins to crystallize in the cooler.

The invention is based on the fact that the solubility of potassium ferrocyanide is dependent on the total potassium ion concentration of a solution. Thus, whereas the solubility of potassium ferrocyanide in water amounts to 28 grammes per 100 c.c. in the absence of any potassium carbonate, the solubility falls to 1.4 grammes per 100 c.c. solution when the solution also contains 45 grammes of potassium carbonate per 100 c.c.

It has been found that if a gas-washing solution which has reached the stage at which it can no longer be employed without the deposition of crystals of ferrocyanide in the cooler is concentrated to about half its bulk and then cooled, most of the ferrocyanide can be recovered in the form of the crystalline hydrated salt $K_4Fe(CN)_6 . 3H_2O$.

The invention accordingly comprises in a process for the recovery of potassium carbonate, potassium thiocyanate, and potassium ferrocyanide from spent alkaline liquor which has been employed for scrubbing crude coal gas the step of recovering the potassium ferrocyanide by concentrating the spent liquor—*e.g.*, to half its bulk—and removing the potassium ferrocyanide which crystallizes out from the liquor upon cooling.

The mother liquor after removal of the potassium ferrocyanide consists of a solution of potassium carbonate and potassium thiocyanate, but the separation of these salts from one another by the normal process of concentration and cooling is not possible since the composition of the solid at the invariant point on the phase rule diagram for the system K_2CO_3—KCNS—H_2O is similar to that of the solution from which the solid is to be separated. It has been found, however, that the position of the invariant point changes rapidly with temperature, and by carrying out the crystallization at a high temperature an efficient separation is possible. Thus, the composition of the solution at the invariant point of the system K_2CO_3—KCNS—H_2O at 25° C. is 29% K_2CO_3, 33% KCNS, and 38% H_2O and at 50°C. is 12% K_2CO_3, 60% KCNS, and 28% H_2O. If the mother liquor from the ferrocyanide crystallization is concentrated and allowed to crystallize at an elevated temperature—*e.g.*, at 50°C.—potash is recovered in the form $K_2CO_3 . 3/2\ H_2O$.

Cooling of the mother liquor from the carbonate crystallization to 25°C. with or without further concentration results in the separation of potassium thiocyanate in the pure anhydrous form. The mother liquor is mixed with the mother liquor resulting from the recovery of ferro-cyanide from the next batch of liquor treated, and passes through the salt recovery process again.

In an alternative form of the process, the mother liquor from the carbonate crystallization is treated with carbon dioxide to convert all the carbonate to bicarbonate, which is relatively insoluble in the presence of high concentrations of potassium thiocyanate. At 25°C. the composition of the liquor at the invariant point of the system is potassium bicarbonate 1%, potassium thiocyanate 69.5%, water 29.5%.

Following is a description by way of example of one method of carrying the invention into effect.

Example.

The liquor discarded from a coal gas purification system was found to have the following composition :

Total potash 1.22 lb./gallon (as K_2CO_3).
Potassium thiocyanate 0.344 lb./gallon (as KCNS).
Potassium ferrocyanide 0.341 lb/gallon (as $K_4Fe(CN)_6$).

100 gallons of the solution were concentrated to 43.6 gallons and subsequently cooled to 15°C. The crystals deposited were filtered off and washed.

31.9 lb. of crystals were recovered having the following composition.

$K_4Fe(CN)_6$	90%
K_2CO_3	0.1%
$KHCO_3$	1.9%
H_2O	8.0%

This represents a recovery of 84% of the quantity of the potassium ferrocyanide in the liquor.

The mother liquor together with the washings from the potassium ferrocyanide crystals was concentrated by boiling until the concentration of potash in the solution was 62% by weight. The solution was then cooled to 50°C., and the crystals formed were filtered off and pressed. The quantity recovered was 144 lb., and the composition was :

$K_2CO_3 . 1\frac{1}{2}H_2O$ . . .	96%
$K_4Fe(CN)_6 . 3H_2O$ . . .	4%

The crude salt was returned to the solution in the gas purification plant and the mother liquor evaporated until the concentration of carbonate in the solution was 14% by weight. The liquid was cooled to 25°C., and the thiocyanate which crystallized out separated, washed, and pressed. This operation yielded 30 lb. of crude thiocyanate and 20 lb. (1¼ gallons) of a liquor containing 30% carbonate and 30% thiocyanate by weight. The solution was reserved for future treatment with a fresh batch of gas-washing liquor.

The gas-washing liquor may be treated a number of times for the removal of potassium ferrocyanide and potassium carbonate before being treated for the removal of potassium thiocyanate therefrom.

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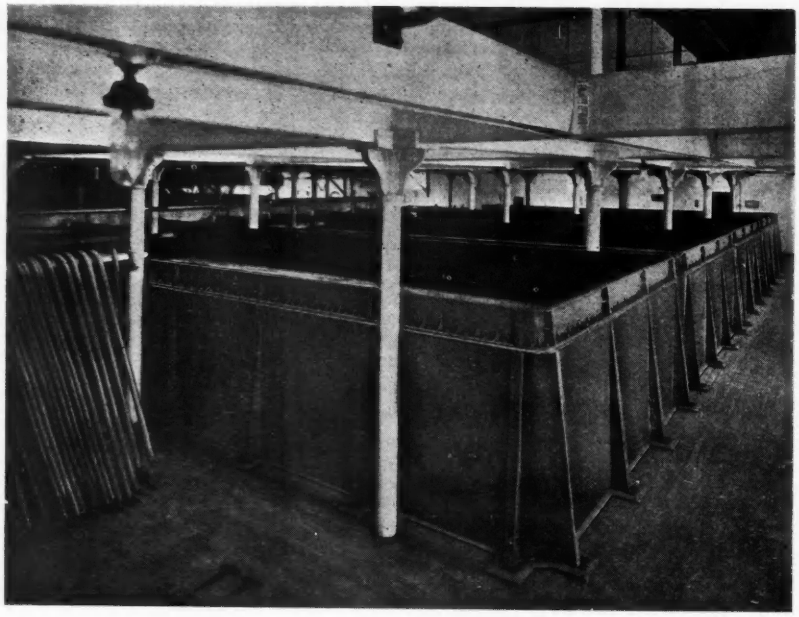

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COMPANY MEETING

Oriental Gas Company, Ltd.

The Annual General Meeting of the Oriental Gas Company, Ltd., was held at the London Office of the Company, Finsbury House, Blomfield Street, E.C. 2, on Thursday, Dec. 12, 1940—Mr. B. W. ELLIS, A.M.Inst.C.E. (Chairman of Directors), presiding.

The SECRETARY (Mr. A. W. Hentsch) read the notice convening the meeting, together with the Auditors' report.

The Chairman's Address

The CHAIRMAN, in moving the adoption of the Directors' Report and Statement of Accounts for the financial year ended June 30, 1940, said : We regret that we are a fortnight late this year in the issue of our Report and Accounts and the calling of the Annual Meeting—occasioned by the delays in mail transit. That it is no worse is due to the energy of our London staff. They have been working in comparative quietude in their new quarters for the past year with little upset to the usual routine.

We will now consider the accounts if, as I assume, we may take them as read.

As indicated last year, the Accounts are now kept at 1s. 6d. per Rupee, but in any comparison in the Revenue Account that I may make with last year, the figures have been adjusted from 1s. 4d. to 1s. 6d. so as to form a true picture.

The Capital Account is unchanged. In the Revenue Account coal has cost more by £1,800 as 2,827 tons more have been carbonized. Salaries are lower by £530. Carbonizing Wages are higher by £500 as allowances have been made to our men to meet the rise in cost of living. Purification has for this year disappeared as a debit, the sale of spent oxide realizing more than the charge under this head.

Repair and Maintenance of Works Plant shows an increase of £8,430, largely Retort renewals to meet the winter's call on our carbonizing capacity. The actual increase is somewhat higher as we have included less Capital Expenditure in it than in last year. Total manufacturing costs are higher by £9,700.

Distribution

Salaries are higher by £285 ; these are normal increases. The increase in Repairs of Mains and Services is £6,030, but we have charged to Revenue the cost of over two miles of new 9-in. main. The actual increase is £620, and this is partly increase in wages. Meters show a rise of £374. Fittings are £3,330 lower. A larger proportion of these, especially geysers, have been sold outright instead of being placed out on hire. Besides the resulting profit, the labour charges have been lower. Total distribution costs are £3,360 higher.

Public Lamp Maintenance remains the same, and Rent, Rates and Taxes show a drop of £650. Though we paid tax at a higher rate, it was on a lower assessment.

Then as to Management, Directors' Fees are higher by £197, and London Office salaries by £106, due to higher income-tax payments. Calcutta Office salaries are up by £1,470. Some of this is caused by clerical labour previously charged to other departments. Stationary and Printing and General Charges are both lower. Total Management costs are £1,630 higher.

There is a slight rise of £23 in Bad Debts, and £70 on Law Charges. Superannuations are £1,140 lower, as last year bore an exceptional charge for retiring allowance. Provident Fund has increased by £70, and Gratuities to Workmen by £220, a greater number of men having left us. Passages are £700 lower owing to wartime restriction of leave. Revenue expenditure is higher by £12,590, but this includes £8,826 Capital Expenditure charged to Revenue against £5,327 in 1938–39.

More Gas Sold

Receipts from sales of gas have increased by £9,630, the quantity sold being over 700 million cu.ft. This is an increase of 8.9% in quantity and 7% in money. Meter and Cooker Rentals also are £250 higher.

Residuals show an increase of £3,365, we having sold more coke at a higher price. Tar receipts are also up owing to price, as a less quantity was sold. Purification appears as a credit item for the reasons given you earlier. Rents and Transfer Fees show little or no change. Total receipts are higher by £13,670, and after deducting the increase in expenditure the trading profit is £1,078 higher.

Turning to the Net Revenue Account, Bank Interest is £33 higher, interest on investments £186 lower on account of a higher rate of tax. Exchange Adjustment, as explained in the Report, is occasioned by the writing up in Rupee value of cash and stocks in India from 1s. 4d. to 1s. 6d. Consequent on this, the item of Exchange has moved to the other side of the account as indicated last year, the remittance rates having been slightly below 1s. 6d. The Reserve and three following accounts are unchanged. The final balance carried to Balance-sheet is £156,918. In this the amounts due by the Company are £7,503 higher. On the other side, cash at Bankers is lower by £6,875. Investments are £11,000 higher, this sum having been placed in Government War Securities. Stock value is £10,887 higher and amounts due to the Company £4,500 higher. All these figures, except the cash in London and investments, you will remember, are affected by the alteration in the calculation of exchange. I would add that the Stock Exchange value on June 30 last of the Company's investments was above that shown in the Balance Sheet. The increase in consumption of gas during the year is mainly due to industrial development ; still the domestic part shows a decided increase. The percentages are as follows :

Public lighting	40%
Private and domestic . .	25.6%
Industrial	28.7%
Institutions	5.7%

The increase in the industrial percentage is 4.9% over last year, which itself showed an increase of 2.4% over the 1937–38 sale under this head, and this class of consumption has been stimulated by war conditions. The effect is to bring down our average return in money per million.

Amicable Relations

During the year our relations with the Public Authorities have been most amicable and satisfactory. At Sealdah and Howrah the condition of the Works has been fully maintained. We have laid a new 9-in. main from the Works to the South of the City and installed a boosting plant in connexion therewith. We can generate our own electricity for this, but can also draw from the local supply, so that each acts as a standby in case of trouble. The Meter and Fittings Department have been active as is shown by the addition of over one thousand new appliances fixed. This, under existing conditions, is very satisfactory.

Labour generally has been quiet and undisturbed, having been treated with firmness and fairness, allowances to meet rising costs of living having been conceded. This, with the rise in cost of all our supplies, both imported and local, has occasioned the large increase in our expenditure, and we are entitled to take credit for not having raised our price for gas. In refraining from this the practical effect is equivalent to a reduction in times of static costs, which is what we have always aimed at.

The war has made working difficult for our staff in Calcutta. Fortunately, our shipments of goods from Britain have not suffered. Year by year we are more able to fill our requirements from Indian sources, and this move will tend to increase.

I have endeavoured to avoid wearying you with overmuch detail, but if there is any further information required I shall be glad to furnish it to the best of my ability.

The CHAIRMAN then formally moved the adoption of the Report and Accounts, which was seconded by Mr. STANLEY H. JONES, M.Inst.C.E., and carried unanimously.

Dividends

The CHAIRMAN thereafter proposed :

> " That a final dividend of 4½%, less income tax, be declared, making 8%, less income tax, for the year ended June 30, 1940, and that the warrants for the same be sent by post to the proprietors on Dec. 12, 1940."

This was seconded by Mr. B. M. GILL and unanimously agreed.

Re-election of Directors and Auditors

Mr. STANLEY H. JONES proposed the re-election to the Board of Mr. B. W. Ellis and Mr. W. G. Bradshaw, being the two Directors retiring by rotation at that meeting. Referring to the Chairman, Mr. Jones said it was a great pleasure to propose the re-election of one whom he had known from boyhood, and who very generously took over the Chairmanship of the Company when he himself had to give it up as a result of ill-health. They could see how well he fulfilled those duties. It was unnecessary to say anything to recommend him to them ; his knowledge of the Company went back further than anyone in that room. He was an old official of the Company and son of a distinguished Chairman. There was no one better qualified to fill the position. With regard to Mr. Bradshaw, they very much regretted his absence on that occasion due to illness ; and they hoped he would be back with them again in due course.

Mr. GILL seconded the resolution, which was carried unanimously, and the CHAIRMAN briefly acknowledged their re-election on behalf of Mr. Bradshaw and himself, observing that he hoped they would continue to deserve the proprietors' confidence.

On the proposition of Mr. S. FIELD, seconded by Colonel W. PARKER, the Company's Auditors (Mr. S. W. Savage and Mr. F. J. Bradfield) were re-appointed, Mr. BRADFIELD returning thanks on behalf of his colleague and himself.

Votes of Thanks

Colonel PARKER proposed a hearty vote of thanks to the Chairman and his colleagues, as well as to the staff, both in Calcutta and in London for their conduct of the Company's business during a very difficult year.

Mr. E. J. CARTER, seconding the vote of thanks, drew attention to Paragraph 3 of the Directors' Report, which stated that in view of the increased rate of income tax, the Directors had decided that, for the time being, they would not avail themselves of the full remuneration which the proprietors had voted them. He felt sure everyone present would agree that this was a very fine gesture on the part of the Directors, particularly in view of the extraordinary difficulty during the past year of keeping in contact with the staff and works in Calcutta.

The vote was heartily accorded, and, in acknowledging it on behalf of himself and his colleagues, the CHAIRMAN observed that the vote of thanks to the staff was one the proposal of which he somewhat selfishly reserved to himself. With reference to the staff in Calcutta he observed that all leave, except local, was stopped by the war and they had not had Mr. Savage home this year to their disappointment. The working and financial results which were before the meeting spoke for the success of their General Manager and his staff, both European and Indian, on their behalf. Their record for output and sales had once more been beaten. Mr. Savage had just returned from a short and overdue holiday, during which Mr. Gladstone had taken his place. This was by arrangement with the Bombay Company. Mr. Lyle, who was on sick leave and was with them at their meeting a year ago, had not recovered his health as they had hoped. He had, to their sincere regret, found himself compelled to resign his position with them and they were loth to lose him. Mr. Monson had succeeded Mr. Smith as Works Superintendent to their satisfaction. Messrs. Atkinson, Bathgate and Pope had handled their departments well. Messrs. Weldon and Page also gave valuable work. The London staff, as he must still call them, had been very much under his observation in the last twelve months and had done well under strange and new conditions. Their staff and workmen from Mr. Savage down had shown them to be, in the fullest meaning of the words, a public utility company, and he asked the meeting to accord them a sincere vote of thanks.

Mr. GEORGE EVETTS, M.Inst.C.E., in seconding the vote of thanks, said the fact that although costs had been continuously rising since the beginning of the war their charges had not been increased and their service had been in no way curtailed was the best testimonial their officers and staff could have.

The vote was unanimously accorded, and the SECRETARY briefly responded and said he would have much pleasure in conveying their expression of thanks to Calcutta.

The meeting then terminated.

Action Against Glasgow Gas Manager Fails

JUDGMENT in an action for £10,000 for alleged slander, brought against the General Manager and Engineer of the Glasgow Gas Department, Mr. J. W. McLusky, has been issued by Sheriff-Substitute Guild at Glasgow Sheriff Court. The decision is in favour of Mr. McLusky.

The action was raised in Paisley Sheriff Court in October, 1937, by Mr. Robert Maclaurin. The hearing was transferred to Glasgow Sheriff Court in 1939, and the leading of evidence began on June 21 before Sheriff Guild. On five occasions from that date the Court set aside several days for the hearing, which extended over 19 days, and was concluded towards the end of last year. Notes of the evidence ran to 1630 pages and, in addition, there were 163 pages of evidence taken on commission. The Sheriff's judgment required 37 pages, and his note 149 pages.

Mr. Maclaurin's claim was based on tests of a low temperature carbonization process known by his name and invented by him. He alleged that the defender published false, malicious, and calumnious statements and figures regarding that process, and, according to the record, caused the pursuer serious loss, injury, and damage. The reputation of the process and of the pursuer as a technical chemist, it was further alleged, had been gravely damaged by the defendant's statements and reports, which were widely circulated, and the prospects of marketing the process had been seriously injured for the future.

A Joint Test

In 1915, according to pursuer's averments, both the Gas and Electricity Departments of Glasgow Corporation agreed to carry out a joint test of the process, but on account of the war the experiments were postponed. About 1922 Mr. McLusky, who had become Manager of the Gas Department in 1919, at the request of the Gas Committee prepared an account of tests carried out at Mr. Maclaurin's plant at Grangemouth. That report did not differ materially from the defender's statement, and ultimately it was agreed to erect a battery of five Maclaurin producers at Dalmarnock. These were worked from 1925 to 1932. Later, no attempt was made to secure an outlet for the gas, and the smokeless fuel account, it was alleged, was framed by the defender with the deliberate intention of showing as great a loss as possible in the operation of the Maclaurin plant.

The answers of the defender indicated that he at no time used his influence unjustly to prevent the use of the process. Had the process been commercially sound, which it was not, the defender would have had no hesitation in recommending its use by Glasgow Corporation. The working of the plant was at first unsatisfactory, but that was largely surmounted by the efforts of the defender. He and other servants of the Corporation used all their endeavours to make a commercial success of the process, without avail. His report and documents were true, and were honestly and properly made by him in the discharge of his duty to Glasgow Corporation.

Sheriff Guild, in his judgment, has found that there was no evidence of malice on the part of the defender to the pursuer in person or to the plant. He had found in law : (1) That the reports complained of were not slanderous ; (2) that the reports complained of were issued by the defender on privileged occasions ; (3) that in any event, there being no evidence of malice, the reports complained of, even if false, did not give the pursuer a ground of action. He assoilzies the defender from the conclusions of the action, and finds the defender entitled to expenses as between agent and client.

Complete Justification

During the seven years of its operation, the Sheriff points out in this note, the plant was shown to have caused a loss of more than £30,000 to the Corporation. In view of these figures there would appear to be complete justification for the defender's statement (that the Maclaurin process had failed as a commercial proposition), unless there was some element in the situation which the figures did not reveal. Pursuer's explanation was that the plant had never been run as a commercial proposition. In that connexion the terms of the original allowances of proof presented some difficulty. Inasmuch as the substance of the slander complained of was that the plant had been a commercial failure, it was obvious that that averment was of crucial importance.

" Had I dealt with the case at the stage of the debate on relevancy I should most certainly have hesitated, to say the least of it, to allow an averment so completely lacking in specification to go to proof at all. Had there been a definite specification of the way in which Glasgow Corporation had failed to run the plant as a commercial proposition and the precise activities of the defender which had caused or contributed to that result, it would have been possible to deal with the matter in a satisfactory way. As it is, the Court is left to analyse fragments of evidence relating to a crucial question scattered up and down 1800 pages of evidence, these in their turn being based on averments scattered through a record of 31 pages."

Towards the end of his note, Sheriff Guild says : " The result at which I have arrived is that the pursuer's claim fails, and that the question of damages does not arise. . . . There is not a word of evidence in the proof to show what, if any, profit resulted from the erecting of this plant or from its operation. . . . All that appears is that the two companies concerned (Maclaurin Coal Products, Ltd., and Maclaurin Carbonization, Ltd.) have, during the last 20 years, lost upwards of £60,000. It is quite true that this money has been spent, and possibly well spent, in experimental and development work in connexion with what may prove a process of value. But evidence of profit there is none.

" In these circumstances, as data of a sort might have been provided for the guidance of the Court and were not, there seems to be no escape from holding that, if damages had been awarded, they would have been nominal."

Gas Products Prices

The London Market

Dec. 16.

The prices of Tar Products in the London Market remain to-day as follows: Pitch is nominal; creosote is about 4¾d. to 5d. per gallon; refined tar about 3¾d. to 4d.; the price of pure toluene under the Ministry of Supply Toluene No. 2 Order is 2s. 5d. per gallon; pure benzole is 1s. 10d.; 95/160 solvent naphtha is 1s. 11d. to 2s.; 90/160 pyridine about 15s.; all per gallon naked; refined naphthalene crystals £23 per ton in bags; all *ex* Makers' Works.

The Provinces

Dec. 16.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North 9½d. to 10d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d. Heavy naphtha, North, 1s. 5d. to 1s. 6d. Creosote, *ex* works, in bulk, North liquid and salty, 4½d. to 4¾d.; Scotland, 4½d. to 4¾d.; low gravity, 4¼d. to 4¾d. Fuel Grade 4d. to 4¼d. Carbolic acid, 60's, 3s. 9d. to 3s. 10½d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4¼d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, p. 404.

Tar Products in Scotland

GLASGOW, Dec. 14.

Quietly steady conditions have prevailed in this market during the week and prices are well maintained.

Refined tar is easing off to some extent, but home price is unchanged at 4¼d. to 4¾d. per gallon, and export business is still being concluded at 3¼d. to 3½d. per gallon, both f.o.r. naked.

Creosote oil.—Production finds a ready outlet as available with prices as under: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6½d. per gallon; neutral oil, 5¾d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid is not too active although some business has been placed during the week as follows: Pale, 99/100%, 2s. to 2s. 2d. per gallon; Pale, 97/99%, 1s. 9d. to 1s. 10d. per gallon; Dark, 97/99%, 1s. 6d. to 1s. 7d. per gallon; all *ex* Works in buyers' packages.

Crude naphtha is still valued at 6½d. to 7½d. per gallon *ex* Works in bulk.

Solvent naphtha.—90/160 grade is 1s. 8½d. to 1s. 9d. per gallon and 90/190 Heavy Naphtha is 1s. 4½d. to 1s. 5½d. per gallon.

Pyridine is in poor request, with prices called 17s. to 18s. per gallon for 90/160 grade and 19s. to 20s. per gallon for 90/140 grade.

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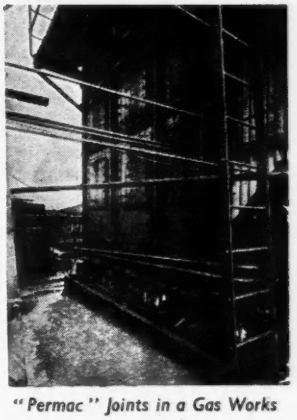

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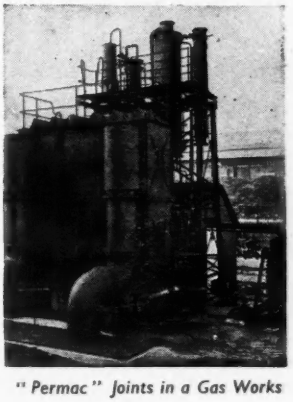

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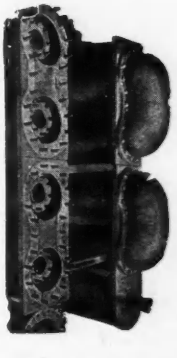

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GAS STOCKS AND SHARES

Quiet conditions again persisted in most markets of the Stock Exchange last week although the Allied successes in the East led to some activity with rising prices in those markets concerned, notably among oil shares. Gilt-edged stocks remained firm but the volume of business in this section was not large enough to affect prices much either way—2½% Consols closed ¼ higher at 76¼. Some reactions were noticeable among home rails. In the foreign market Greek and Egyptian bonds were naturally harder. Prices in the Industrial section fluctuated and although some early gains were registered these were not held. Rubber and tea shares remained idle, but more interest developed in the Kaffir market.

There were more transactions in the Gas Market than for some time past, although with the exception of Gas Light units, which hardened a further 3d. to 14s. 6d., the few changes in the Official List were in a downward direction. The heaviest fall occurred in East Surrey "B" stock, which closed 12½ points lower at 65. This price is more in accordance with current values, although the last recorded transaction in this stock was at 95½ in May last. On the Provincial Exchanges Liverpool ordinary hardened 2½ points to 98½ and it will be seen that two reactions occurred in the Supplementary List.

The Directors of the Plymouth and Stonehouse Company have declared an interim dividend of 3¼% on the 5% stock. This compares with 3½% for 1939. The Deal and Walmer Company has passed the dividend on its 4% preference stock.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Dec. 12.	Rise or Fall on week.
1,767,439	Sept. 16	7	7	Alliance & Dublin Ord. ...	112—122	...
374,000	July 1	4	4	Do. 4 p.c. Deb. ...	90—95	...
957,608	Nov. 4	5	5	Ascd. Gas & Water U'd'ts Ord.	12/—14/—	...
300,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	15/6—17/6	...
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
136,646	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	12/—14/—	...
561,370	Aug. 12	7	7	Barnet Ord. 7 p.c.	98—103	...
300,000	Oct. 14	1/9⅜	1/4⅜	Bombay, Ltd.	19/6—21/6	...
690,407	Aug. 19	7	7	Bournemouth 7 p.c. max. ...	100—110	..
362,025	June 17	4	4	Do. 4 p.c. Deb. ...	80—85	+2½
659,955	Aug. 19	6½	4⅝	Brighton, &c., 5 p.c. Con. ...	65—75	...
855,000	Sept 30	8	6	Brit. Gas Light Ord.	75—85	...
545,000	June 17	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	110—115	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	75—80	...
10,000	Nov. 6, '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	½—¾	...
626,860	July 15	5⅛	6	Cardiff Con. Ord.	89—94	...
24,500	Sept. 23	7	7	Colombo Ord. 7 p.c. Pref. ...	19/—21/—	...
764,169	Oct. 7	/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	14/—16/—	...
400,000	,,	1/3.30	1/3.30	Do. 8 p.c. Pref. ...	19/—21/—	...
1,748,935	July 22	2	3	Commercial Ord.	37—42	...
620,000	Dec. 9	3	3	Do. 3 p.c. Deb.	57—62*	—1
286,344	Aug. 19	5	5	Do. 5 p.c. Deb.	87—92	...
807,560	Aug. 12	7	6	Croydon sliding scale ...	83—88	...
644,590	,,	5	5	Do. max. div.	79—84	...
620,385	July 1	5	5	Do. 5 p.c. Perp. Deb. ...	90—95	...
179,500	Aug. 19	5⅜	5	East Surrey 'B,' 5 p.c.	60—70	—12½
176,461	June 17	5	5	Do. 5 p.c. Deb. (Irred.)...	90—95	...
250,000	Nov. 11	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	Nov. 11	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/—	...
19,123,081	July 29	3⅜	4½	Gas Light & Coke Ord. ...	14/—15/-a	+-/3
2,600,000	,,	3½	3½	Do. 3½ p.c. max.	50—55	...
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	71—76	...
2,993,000	July 8	3½	3¾	Do. 3¾ p.c. Red. Pref. ...	80—85	...
8,602,497	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	67—72*	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	100—105*	...
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	98—103*	...
700,000	Sept. 9	3½	3½	Do. 3½ Red. Deb. ...	80—85	...
3,600,000	May 13	4	8	Imperial Continental Cap. ...	35—40	...
43,820	July 29	3½	3½	Do. 3½ p.c. Red. Deb. ...	63—68	...
231,978	Aug. 19	5	5	M.S. Utility 'C' Cons.	68—73	...
918,657	,,	4	4	4 p.c. Cons. Pref.	72—77	...
675,000	Nov. 11	†4	†4	Montevideo, Ltd.	52—57	...
300,000	Nov. 18	7	9	Oriental, Ltd.	95—105	...
368,537	Dec. 9	8	6½	Plymouth & Stonehouse 5 p.c.	88—98*	—2
621,667	Aug. 19	8½	7½	Portsmouth & Gosport Cons.	90—95	...
648,999	Sept. 16	1/1	1/1½	Severn Val. Gas Cor. Ld. Ord.	13/—15/—	...
597,972	,,	-/10⅜	-/10⅜	Do. 4½ p.c. Cum. Pref. ...	15/6—17/6	...
2,528,714	Sept. 2	1/—	-/7½	South East'n Gas Cn. Ld. Ord.	9/—11/—	...
1,000,000	,,	-/10⅜	-/10⅜	Do. 4½ p.c. Red. Cum. Pref.	14/—16/—	...
1,068,869	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	13/—15/—	...
6,709,895	Aug. 5	4	4	South Met. Ord.	53—58	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	95—105	...
650,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	69—74	...
1,895,445	July 1	3	3	Do. 3 p.c. Perp. Deb. ...	60—65	...
1,000,000	July 15	5	5	Do. 5 p.c. Red. Deb. ...	97—102	...
1,543,795	July 22	3	4	South Suburban Ord. 5 p.c. ...	62—67	...
512,825	July 8	5	5	Do. 5 p.c. Perp. Pref. ...	85—90	...
300,000	,,	4	4	Do. 4 p.c. Perp. Pref. ...	60—65	...
250,000	,,	3½	3½	Do. 3½ p.c. Red. Pref. ...	80—85	...
888,587	June 10	5	5	Do. 5 p.c. Perp. Deb. ...	92—97	...
750,541	Aug 9	5½	5	Southampton Ord.	57—62	—1
350,000	Feb. 12	5½	5½	Swansea 5½ p.c. Red. Pref. ...	91—96	...
1,076,495	Aug. 5	5	5	Tottenham & District Ord. ...	62—67	...
338,555	,,	5	5	Do. 5 p.c. Pref.	78—83	...
453,380	Dec. 9	4	4	Do. 4 p.c. Perp. Deb. ...	76—81*	—1
1,247,505	May 20	4	6	U. Kingdom Gas Cor. Ord. ...	13/—15/—	...
1,085,952	Nov. 25	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	...
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/—	...
745,263	June 17	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	12/6—14/6	...
1,200,000	Sept. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	82—87	...
380,606	Aug. 5	7	6½	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	July 8	3½	4	Wandsworth Consolidated ...	66—71	...
2,525,768	,,	4	4	Do. 4 p.c. Pref.	60—65	...
1,343,964	June 17	5	5	Do. 5 p.c. Deb.	90—95	...
383,745	,,	4	4	Do. 4 p.c. Deb.	80—85	...
558,342	July 15	6	5	Watford & St. Albans Ord. ...	88—93	...
300,000	Dec. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89*	—1

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Dec. 12.	Rise or Fall on week
351,685	June 17	5	5	Brighton, &c., 5 p.c. Perp. Deb.	90—95	...
28,700	,, 17	5½	5½	Do. 5½ p.c. Red. Deb. 1942 ...	96—101	...
415,250	,, 17	4	4	Bristol Gas Co., 4 p.c. New Deb.	85—90	...
140,205	July 29	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110	...
295,932	Aug. 19	5	5	Cheltenham, 5 p.c. Cons. Ord....	88—93	...
42,500	July 1	4	4	Do. 4 p.c. Perp. Deb....	82—87	...
150,000	Aug. 12	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	65—75	...
130,000	July 1	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Aug. 19	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	90—95	...
53,220	,, 19	6	6	Do. 6 p.c. Cum. Pref. ...	95—100	...
117,425	Feb. 5	8	8	East Wight, 5 p.c. Cons. Ord. ...	100—110	...
...	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c.... ...	65—75	...
239,135	Nov. 11	5	5	Gas Consolidation 'A' Ord. (£1)	13/—15/-	...
156,600	Aug. 19	5	5	Hampton C't, 5 p.c. Cons. Ord.	68—73	...
18,000	Dec. 2	7	7	Malta & Med'n., 7 p.c. 1st Pref.	55—65	...
10,845	,, 2	7½	7½	Do. 7½ p.c. 2nd Pref.	55—65	...
50,000	Aug. 19	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	60—70	—3
65,000	Aug. 12	5	5	North Middlesex, 5 p.c. Pref....	87—92	...
70,000	Sept. 9	5	5	Plymouth & Stone., 5 p.c. Deb.	87—92	...
76,501	July 1	4	4	Reading, 4 p.c. Perp. Deb. ...	75—80	...
74,777	Sept. 30	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	June 10	5	5	Slough, 5 p.c. Perp. Deb. ...	90—95	...
211,740	,, 17	5	5	Southampton, 5 p.c. Red. Deb.	90—95	—6
363,575	July 1	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	95—100	...
202,019	Oct. 14	6½	6½	Tunbridge Wells, 4 p.c. Scale ...	70—80	...
135,257	June 10	5	5	Uxbridge &c, 5 p.c. Perp. Deb.	90—95	...

PROVINCIAL EXCHANGES

					Quotations Dec. 6.	
47,756	July 26	6	5	Bath Cons.	95—100	...
122,577	July 22	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	July 15	5	5	Bristol, 5 p.c. max.	90—93	...
120,420	June 17	4	4	Do. 1st 4 p.c. Deb.	94—96	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	92—95	...
328,790	,,	5	5	Do. 5 p.c. Deb.	108—111	...
157,150	Aug. 5	6½	5	Chester 5 p.c. Ord.	98—101	...
92,500	June 17	4	4	Do. 4 p.c. Pref.	80—85	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	80—85	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	94—98	...
542,270	Aug. 12	9	6	Derby Cons.	100—105	...
55,000	June 10	4	4	Do. 4 p.c. Deb.	96—102	...
10,000	Aug. 19	10	10	Great Grimsby 'A' Ord. ...	165—175	...
6,500	,,	10	10	Do. 'B' Ord. ...	165—175	...
79,000	,,	10	10	Do. 'C' Ord. ...	155—165	...
732,000	Aug. 26	4	4	Hartlepool G. & W. Cn. & New	61—63	...
2,167,410	Aug. 19	6	6	Liverpool 5 p.c. Ord.	97—100	+2½
245,500	June 17	5	5	Do. 5 p.c. Red. Pref. ...	97½—100½	...
306,083	July 15	4	4	Do. 4 p.c. Deb.	99—101	...
20,000	June 24	5	5	Long Eaton 5 p.c. Pref. ...	9—11	...
80,000	June 24	5	5	Do. 5 p.c. Deb.... ...	92—97	...
2,430,267	July 29	5⅞	5	Newcastle and Gateshead Con.	16/—17/-a	...
682,856	,,	4	4	Do. 4 p.c. Pref.	74—76	...
776,706	Dec. 27	3½	3½	Do. 3½ p.c. Deb.... ...	80—85	...
277,285	April 24	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	July 26	5	5	Newport (Mon.) Ord.	89—93	...
13,200	Sept. 16	8½	7	Pontyp'l Gas & W. 10 p.c. 'A'	11¼—12½	...
13,600	,,	6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	,,	5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Aug. 5	8	10	Preston 'A' 10 p.c.	157—167	...
188,219	,,	7	7	Do. 'B' 7 p.c.	113—123	...
1,806,339	Aug. 26	6½	6½	Sheffield Cons.	118—120	...
95,000	July 8	4	4	Do. 4 p.c. Deb.	97— 99	...
332,351	Feb. 5	6	6	Sunderland 6 p.c. max. ...	107—112	...
140,778	Aug. 12	5	5	Weston-super-Mare Cons. ...	80—85	...
64,338	June 24	4	4	Do. 4 p.c. Deb.	75—85	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	137—145	...

a.—The quotation is per £1 of Stock. * Ex. div. † Price free of income-tax.

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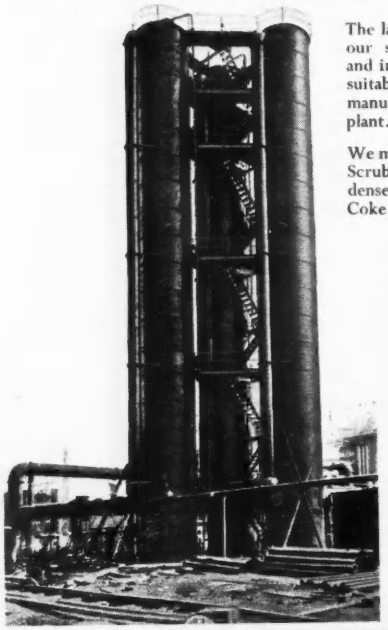

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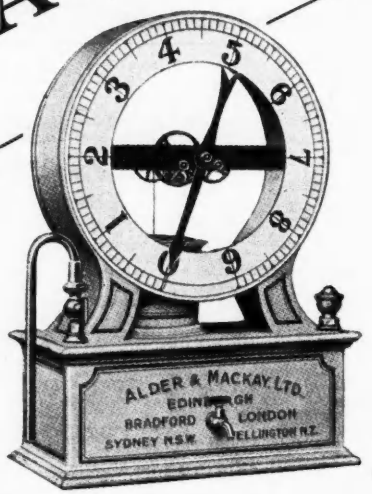

Illustrated is the Circle Gauge for 9" readings which is a particularly sensitive instrument. The brass spindle is located on roller bearings and the black figures are 1¼" high on a 14" diam. white enamelled dial. The filling plug and gas connection are interchangeable.

Further particulars of other gauges and prices will be sent on application.

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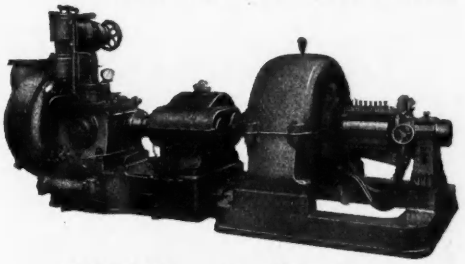
Advertisement Index, see p. 577.

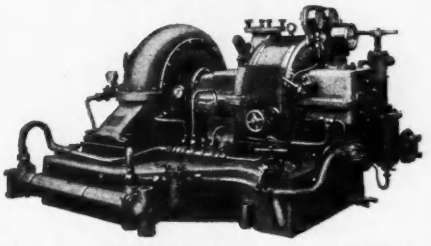
BROTHERHOOD
STEAM TURBINES FOR GASWORKS

Our Turbines, made for all powers up to 15,000 B.H.P. and for all conditions of service, are installed for driving Exhausters, Boosters, and Generators in many Gas Works, including:—

The Gas Light & Coke Co., South Suburban Gas Co., Wandsworth & District Gas Co., and in Works of Corporations and Companies at—Birmingham, Bristol, Coventry, Cardiff, Exeter, Liverpool, Manchester, Newcastle-on-Tyne, Preston, Portsmouth, Sheffield, Smethwick, Toronto, etc.



300 kW Back Pressure Geared Turbo-Generator.



Exhauster driven by 150 B.H.P. Steam Turbine at 13,000 r.p.m.

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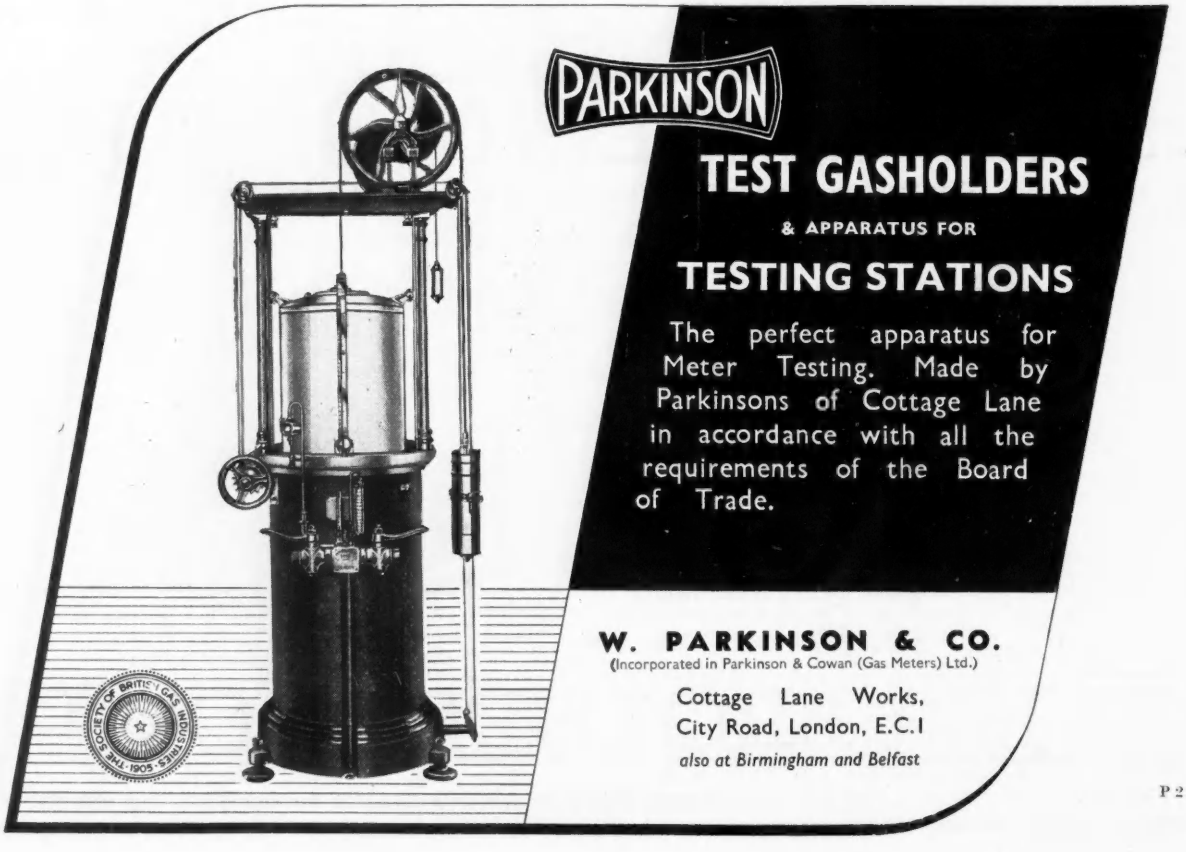
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